AIDGAP
AIDS TO IDENTIFICATION IN DIFFICULT GROUPS OF ANIMALS & PLANTS

A FIELD KEY TO THE BRITISH RED SEAWEEDS (RHODOPHYTA)

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INTRODUCTION

The larger seaweeds (marine ALGAE) are classified into four major groups according to the pigments (coloured compounds) they contain, and by other chemical and structural features. Usually a seaweed can be placed in one of these major groups by its colour when fresh, although in some species the typical colour of its group may be masked by other pigments. The major divisions are:—

CYANOPHYTA—Blue-green algae; individuals microscopic but sometimes present in large numbers and appearing as small black blobs or coloured slimes.
CHLOROPHYTA—Green algae; grass-green in colour.
PHAEOPHYTA—Brown algae; either olive-green in colour or any shade of brown between golden and very dark (see Hiscock, 1979).
RHODOPHYTA—Red algae (the group covered by this guide); exhibiting a wide range of colours from red or pink to a dark purplish-brown, almost black. They often bleach to a light brown or yellow in bright sunlight and then become difficult to separate from browns (Fig. 1). The base, shaded by the rest of the plant, often remains dark and plants with light upper parts and dark bases are probably red algae.

Red algae on rocky shores are often dark in colour, probably to protect the photosynthetic pigments from damage by strong light, whereas sublittoral plants and those growing in shady places on the shore are usually

Mastocarpus stellatus (= Gigartina stellata) | Laurencia pinnatifida | Laurencia hybrida | Chondrus crispus | Porphyra umbilicalis

FIG. 1
Some littoral species of red algae that are commonly confused with brown algae.

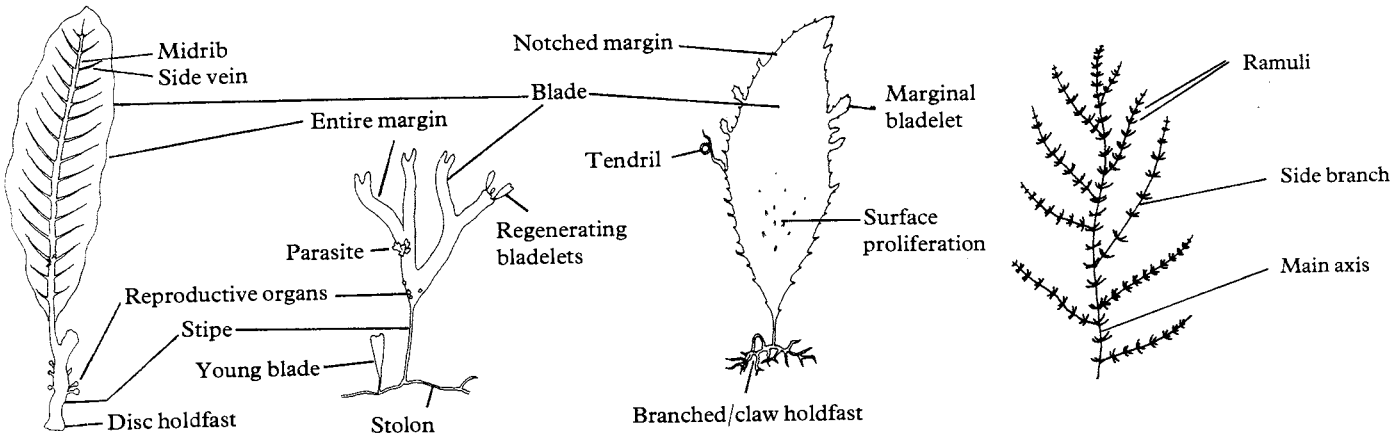


FIG. 2

Parts of a red seaweed.

red or pink. Pressed specimens generally keep their colour well if not exposed to direct sunlight, although some darken on drying. Formalin-preserved material will lose its colour rapidly if not kept cool and in total darkness. Colour and texture of fresh specimens can be useful for identification, but are difficult features to describe and can change in drift or preserved material.

The main features of a red seaweed are illustrated in Fig. 2. It is important to collect the whole specimen if possible, including the holdfast, as basal parts may be diagnostic for some species. Some red seaweeds have no holdfast, living unattached on the bottom (*e.g.* maerl, Fig. 3), or attached to other algae and animals by specially modified hooked, barbed or curled branches. Others have hard, calcified cell walls and look more like coral or rock than plants (see Fig. 3). These are chalky pink or purple and lack the tiny, regularly arranged compartments of the corals.

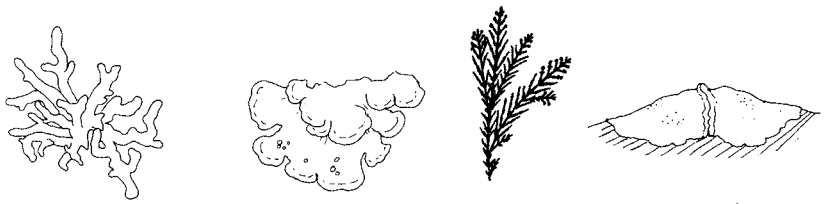


FIG. 3

Some calcified (coralline) red seaweeds.

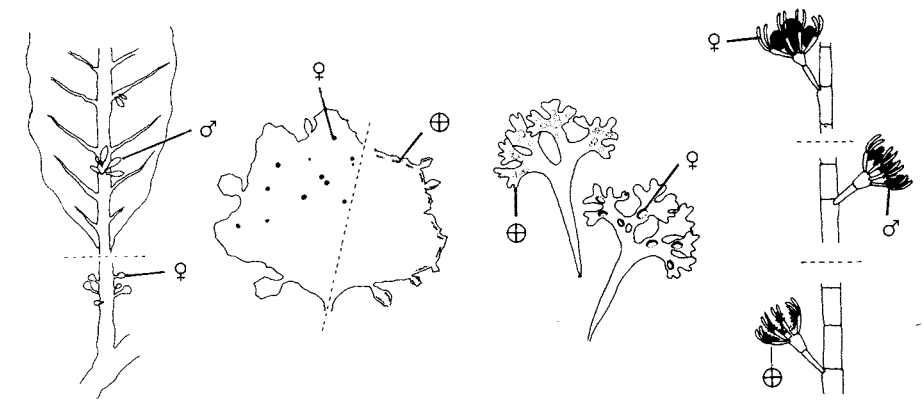


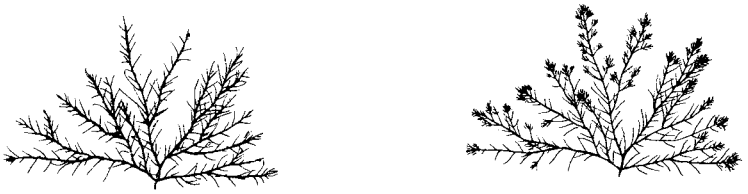
FIG. 4

Reproductive structures of some red seaweeds. ♀-female (cystocarps); ♂-male (spermatangia); ⊕-asexual (tetrasporangia).

Reproductive structures are diverse but important for classification and identification. Some examples are given in Fig. 4. The appearance of plants bearing reproductive structures may be quite different from that of sterile individuals (see Fig. 5). Some species have other phases in their life history which are very different in appearance and key out as separate entities.

Some species of red algae commonly bear small parasites, which can be confused with reproductive structures (Fig. 4). Generally, parasites are paler in colour than the host plant, whereas reproductive structures are darker (occasionally paler after the spores are shed). See Group G, p. 69 for descriptions of parasites.

Some red algae show marked seasonal differences in appearance, often due to seasonal growth of reproductive organs in special small branchlets (Fig. 5). *Drachiella spectabilis* shows spectacular iridescence in early summer, making the plants very conspicuous underwater, but this is lost later in the season and the plants become much less obvious to the diver. New growth of many species is paler and often thinner than older or perennial parts. Plants with thin membranous parts may lose these in autumn and winter storms, leaving only the tougher midrib or stipe (*e.g. Membranoptera, Delesseria*—see Fig. 10). Many plants regenerate from the frond tips or margins after damage, and the new bladelets usually resemble young parts of the parent plant. But the overall appearance of regenerating plants may be quite different from that of undamaged ones (see Fig. 6).



April September

FIG. 5

Seasonal differences in the appearance of *Rhodomela confervoides.*

Undamaged plant Regenerating new bladelets after damage.

FIG. 6

Appearance of *Stenogramme interrupta* before and after production of marginal and apical bladelets following damage.

ECOLOGY

Some species of red seaweeds have a more or less distinct vertical zonation pattern, on shore and sublittorally, as do the larger brown seaweeds (Hiscock, 1979). The zonation of some red seaweeds is shown in Fig. 7. Many of the more delicate species are confined to the sublittoral where wave action is much reduced, there is no danger of drying out, and temperature and salinity are less variable than on the shore. Others can exist on the shore only in rock pools, where they can withstand wave action and temperature changes but not exposure to the air. Plants growing on open rock on the seashore must be able to cope with wave action, drying from wind and sun, extremes of temperature and the occasional soaking in freshwater from rainfall. Adaptations to the extreme conditions on shore include tough, cartilaginous but flexible fronds to withstand wave action; much-branched or inrolled fronds to hold water and minimise evaporation; cells containing 'masking' pigments which protect the photosynthetic pigments from damage by strong sunlight (hence the very dark colour of many shore seaweeds); and various biochemical adaptations. A few species or phases are ephemeral, occurring only when conditions are favourable, thus avoiding some of the extremes of environmental conditions (*e.g. Porphyra linearis,* winter annual; *Nemalion helminthoides,* summer annual).

Many red algae require conditions of moisture and low light, and are found on shore only under the larger

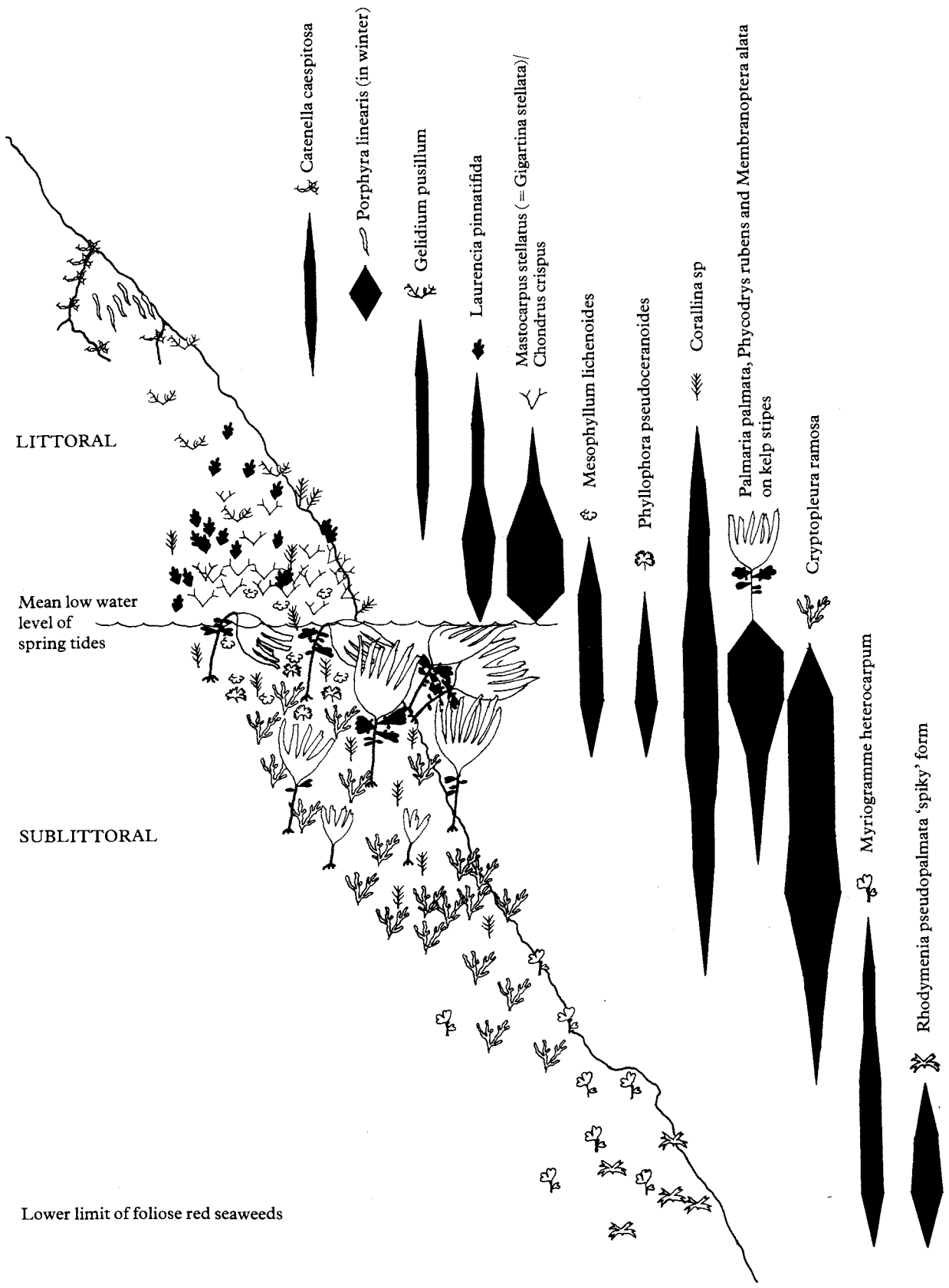
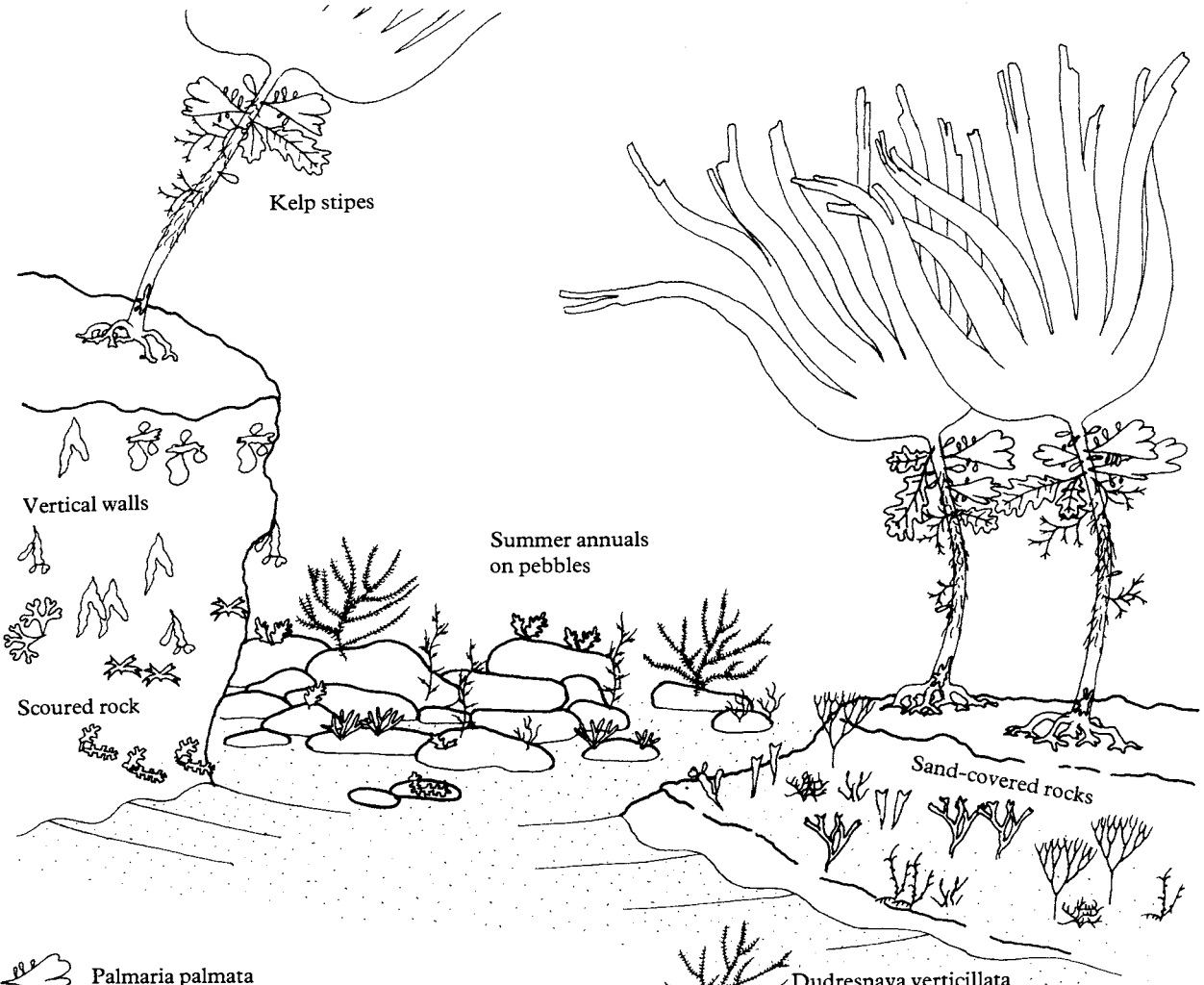


FIG. 7

The vertical zonation of some species of red seaweed at a typical rocky site in southwest Britain. The kite diagrams show the abundance of different species at vertical intervals. The wider the kite, the greater the abundance.



Palmaria palmata
Phycodrys rubens
Membranoptera alata
Polysiphonia spp
Acrosorium reptans
Meredithia microphylla
Schottera nicaeensis
Phyllophora crispa
Rhodymenia pseudopalmata 'spiky'
Rhodymenia pseudopalmata
Radicilingua thysanorhizans

Dudresnaya verticillata
Schmitzia hiscockiana
Scinaia turgida
Naccaria wiggii
Schmitzia neapolitana/
Calosiphonia vermicularis
Grateloupia dichotoma/G. filicina var. filicina
Gracilaria verrucosa
Ahnfeltia plicata
Cordylecladia erecta
Gymnogongrus crenulatus
Polyides rotundus/Furcellaria lumbricalis

FIG. 8

Special habitats of some sublittoral red seaweeds.

brown seaweeds or in crevices, overhangs, caves and rock pools. Microhabitat is probably more important for survival than actual level on the shore and, therefore, vertical zonation patterns are not so clear as for the larger brown seaweeds. In the sublittoral, light levels determine the lower limit for most species, but some red algae show distinct preferences for particular habitats such as vertical walls, scoured rock or rock with some sand cover (Fig. 8). These 'preferences' are probably a response to lack of competition from other species, plant and animal, rather than a need for such habitats, although some algae may require low light conditions. A characteristic community develops in the sublittoral on pebbles and stones which are stable in summer but moved about and scoured by winter storms. Here, summer ephemerals grow quickly and reproduce during the stable summer period. Kelp stipes support another distinct collection of red algae, enabling species which can settle on the stipes to take advantage of a better lit position in the water, and relative freedom from grazing animals. Some species live largely on other algae as epiphytes or parasites.

For further information on the ecology of red seaweeds see Lewis (1964).

EXAMINATION AND PRESERVATION OF SPECIMENS

Collection of specimens should be kept to a minimum. For beginners, it is particularly important to collect the whole plant including stipe and holdfast, as these are sometimes important for identification. As the user becomes familiar with the species and the key, it is often possible to identify species from small parts of the plant. Specimens should be kept cool and wet, and transported in seawater, in a polythene bag or other suitable container.

Plants should be examined initially in a tray of seawater against a white background, where the fronds will float out and any fine filamentous parts can be more easily seen. Fragments can be examined in a petri dish with a hand lens, or on a glass slide held up to the light. Some illuminated hand lenses can be bought, and have proved quite useful. If a low-power microscope is available, it will probably be most useful to use this straight away, and by-pass the hand lens stage. When using a low-power microscope, specimens should be placed in seawater in a shallow petri dish, with the light source from beneath if possible. Where sections of the plant are needed, these can be easily cut by hand with a sharp straight scalpel or safety razor blade. With a little practice, excellent sections can be obtained by cutting thin slivers onto a glass slide, into a drop of seawater. These can be examined under a low-power microscope, or a high-power one after covering the sections with a glass coverslip.

Specimens of seaweeds can be either liquid preserved, or dried (pressed). For identification purposes, it is most useful to liquid preserve, or to press most of the plant and liquid preserve representative parts and reproductive structures. Cellular structure can be much more easily seen in liquid preserved specimens, and only small parts of the plant are needed for this. A solution of 4% formalin in seawater is ideal, use a buffered solution for preserving calcareous algae. Extreme care should be taken when using formalin solution, as the fumes are highly toxic and it should preferably be used only in a fume cupboard. Formalin preserved material will lose its colour rapidly unless kept in absolute darkness, but adding dyes to stain the cell wall materials will enable the cell structure to be seen.

Pressing algae is similar to the procedure for pressing wildflowers, except that algal specimens are difficult to arrange out of water so it is necessary to float them on to a piece of thick cartridge paper or thin card. The card is placed into a tray of seawater beneath the specimen, and both are lifted out together. The card should be labelled (in pencil or waterproof ink) with the species name (if known), date, exact location, position on the shore or depth below Chart Datum if sublittoral, and any habitat information. The specimen on the card is then covered with a piece of muslin (old nylon tights or stockings are even better!). The cards are then sandwiched between layers of newspaper or other absorbent paper and placed in a press—any means of applying pressure evenly will do, down to bricks on a board, but the greater the pressure the better the results. A wildflower press or old linen press is ideal, and latticework presses are best, allowing faster evaporation and drying. Change the newspapers daily, and thin species will be dry in a few days; thicker specimens take longer depending on conditions. When the specimens are quite dry, the muslin can be peeled off carefully, leaving the seaweed stuck to the card. Pressed seaweeds will keep their colour for many years if kept in a dry place out of direct sunlight, and preferably in the dark. Dried specimens can be reconstituted by boiling in seawater for a few minutes with added detergent when cell structure can be examined.

Calcareous algae can be simply dried quickly away from direct sunlight and heat, and should then keep their colour. Surface characteristics of dried specimens such as colour and texture can be useful features for identification.

NOTES ON THE KEY

a. Information in this key is taken from various published and unpublished sources, and from personal experience. See references and acknowledgements, p. 96. This version has been produced after testing of a draft version by many volunteers (see back cover).

b. The key is mainly a 'field' key, using macroscopic characteristics as far as possible, and a × 10 hand lens in places. For the filamentous plants, only a limited number of species can be identified accurately using a hand lens. Many more can be identified with the use of a low power (× 20–40) dissecting microscope; therefore, an extra key (Group D, part 2) for use with a microscope has been included to enable the identification of the majority of filamentous species larger than 1 cm. See above for comments on examination of specimens.

c. Nearly all British macroscopic (larger than 1 cm) red seaweeds can be taken to species level, or if difficult then to a group with references to literature for further information (see p. 96). Littoral, sublittoral and rare species are included. Sizes are given for guidance, and there is a cm scale inside the front cover.

d. Identifications should be checked using Figs 10–35, Newton (1931), Dixon and Irvine (1977), Irvine (1983), and other references given in the key, and if possible with herbarium specimens. When comparing your specimens with illustrations and herbarium specimens, remember that some algae are very variable in form, and may be further altered in appearance by storm and other damage, grazing animals and by a covering of epiphytic plants or animals. This is particularly true in late summer and autumn. Sporelings and very young plants may be impossible to key out without detailed information on cellular structure, and are generally beyond the scope of this key. Nomenclature follows the Parke and Dixon (1976) checklist. Where names have changed since this checklist was published, the old names are given in brackets.

e. If your plant does not key out satisfactorily, check that it is not a brown seaweed (Phaeophyta). See Hiscock (1979) and Fig. 1 of this key.

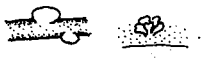
f. Technical terms used in the key have been kept to a minimum, but the use of some unfamiliar words is unavoidable. A glossary is provided at the end.

KEY TO MAJOR GROUPS

START WHERE INDICATED ON THE FLOW DIAGRAM AND CONTINUE UNTIL A GROUP LETTER AND PAGE NUMBER IS REACHED. If a plant has characteristics of more than one Group it should key out in all relevant sections. In the Group keys, start at 'couplet' one, read both descriptions and choose the most appropriate to your specimen. Follow the numbers until identification is achieved. Numbers in brackets indicate where you came from should backtracking be necessary.

START HERE

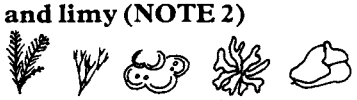
SMALL (<1 cm) PALE PARASITES on other algae (NOTE 1)



YES → **GROUP G** PAGE 69

NO

PLANTS CALCAREOUS hard and limy (NOTE 2)



YES → **GROUP E** PAGE 65

NO

PLANTS ENCRUSTING on rock or other algae (NOTE 3)

YES → **GROUP F** PAGE 67

NO

PLANTS FLATTENED OR COMPRESSED beware flattened growth form (NOTE 4)

YES → **GROUP A** PAGE 10

NO

AXES FILIFORM (CYLINDRICAL, WIDER THAN 0.25 mm) THROUGHOUT, WITHOUT FILAMENTOUS BRANCHES (NOTE 5)

YES → **GROUP B** PAGE 33

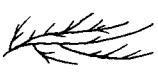
NO

AXES FILIFORM (CYLINDRICAL, WIDER THAN 0.25 mm), BRANCHES OR RAMULI FILAMENTOUS (LESS THAN 0.25 mm WIDE) (NOTE 5)

YES → **GROUP C** PAGE 42

NO

PLANTS FILAMENTOUS THROUGHOUT (NOTE 5)



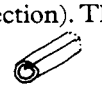
YES → **GROUP D**
D1—Brief key (NOTE 6), PAGE 47
D2—Microscope key (NOTE 7) PAGE 51)

NOTES ON KEY TO MAJOR GROUPS

NOTE 1. GROUP G, PAGE 69. Beware reproductive organs which can resemble parasites. Reproductive structures are usually the same colour as, or darker than, the parent plant, whereas parasites are usually paler than the host.

NOTE 2. GROUP E, PAGE 65. Plants are hard and limy or chalky, pale pink to purple, white when dead. Encrusting on rock or other algae like pink paint, or forming variously shaped nodules of coral-like growth, or with leafy or erect jointed fronds.

NOTE 3. GROUP F, PAGE 67. Plants a thin or thick covering on rock or other algae, of various colours from black through dark red to bright red and brownish red. Very dark crusts can be difficult to distinguish from encrusting brown algae—scrape a bit off and squash to look at colour. Beware of mats of filamentous red algae, which may appear encrusting when the filaments are short (Group D), but individual filaments are easily separable when a small sample is scraped from the rock. From a few mm across to extensive patches.

NOTE 4. GROUP A, PAGE 10. Beware plants with a flattened (pinnate) branching pattern but with cylindrical axes (cut a cross-section). These will key out under Groups B–D. Some flattened plants may be inrolled to appear cylindrical  or gutter-shaped  . Plants may be up to 1 m long.

NOTE 5. GROUPS B, C AND D. It may be difficult to decide between FILIFORM (more than 0.25 mm wide) and FILAMENTOUS (less than 0.25 mm wide), for plants in Groups B, C and D. Where plants do not fit easily into one of these groups, they should key out under more than one group, so choose the closest.

NOTE 6. GROUP D—PART 1, PAGE 47. This is a brief key to species with the smallest branches easily seen with a × 10 hand lens, or with particularly distinctive branching. The key is not complete, and should be used with caution; if a microscope is available, use PART 2.

NOTE 7. GROUP D—PART 2, PAGE 51. This key requires at least a × 20–× 40 dissecting microscope, and the majority of small filamentous red species can be run down using this key.

ACCESSORY KEYS

NOTE: Accessory keys are also provided for a few of the smaller groups: These can be reached through the main keys A–G opposite but can be entered directly if the user is sure that the specimen to be identified belongs to one of these groups. Inexperienced users are strongly advised to proceed through the main keys i.e. from the beginning.

Key to *PORPHYRA* and *PORPHYROPSIS* **Page 32**

Key to *POLYSIPHONIA* and other polysiphonous species (*Pterosiphonia, Lophosiphonia, Brongniartella, Dasya, Heterosiphonia*) **Page 58**

Key to *CERAMIUM* **Page 63**

GROUP A

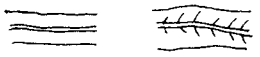
All or some parts of the plant flattened or compressed; may be inrolled to appear gutter-shaped

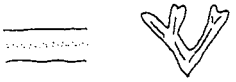
1 — Plants with midrib or veins (look carefully with hand lens—may be indistinct or microscopic) 2

— Plants without midrib or veins 27

2(1) — Plants with midrib (may also have side veins) 3

— Plants without midrib; macroscopic or microscopic veins present (use hand lens against the light—microscopic veins only just visible) 15

3(2) — Midrib distinct, not interrupted  4

— Midrib indistinct or interrupted  9

4(3) — Branches and bladelets arising from centre of midrib only  5

— Branches arising from midrib margin, or branched only from the stipe, or plants unbranched. (Occasionally with tiny reproductive bladelets on stipe or midrib, or regenerating after damage)  6

5(4) — Frond tips pointed. Rose to pale pink; little to much branched, frond to 2 mm wide (rarely to 4 mm) and 20 cm long. Lower littoral and sublittoral into deep water. Common 

Hypoglossum woodwardii (*Fig. 10*)

— Frond tips rounded. Dark red to pale pink; to 9 mm wide and 10(16) cm long. Lower littoral and sublittoral 

Apoglossum ruscifolium (*Fig. 10*)

6(4) — Frond less than 4 mm wide (rarely to 5 mm), midrib with narrow lamina each side 7

— Frond more than 4 mm wide, up to 9 cm wide 8

7(6) — Usually much branched, alternate or subdichotomous. Small side veins seen with hand lens. Lamina often worn away in older parts and in winter. Lower littoral and sublittoral, particularly on kelp stipes. To 10(20) cm long 

Membranoptera alata (*Fig. 10*)

— Unbranched (rarely branched once or twice from the margin), side veins microscopic
young **Hypoglossum woodwardii** (*see 5a and Fig. 10*)
and young **Apoglossum ruscifolium** (*see 5b and Fig. 10*)

8(6) — Blade edge may be ruffled but not deeply indented, resembling elongated beech leaves. Usually branched only from, or near base. Thick stipe, lamina often worn away in winter and stipe bearing stalked reproductive organs. Plants to 40 cm long. Common on rock, from lower littoral pools into deeper water 

Delesseria sanguinea (*Fig. 10 & front cover plate*)

GROUP A

— Blade edge notched, indented between side ribs, resembling oak leaves. May be much branched and little to deeply divided. To 20 cm long. On rock and mussels, often abundant on kelp stipes. Finely dissected form in north. Lower littoral and shallow sublittoral; deeper sublittoral in the north

Phycodrys rubens (*Fig. 10*)

9(3) — Midrib interrupted, formed from a line of reproductive organs on the female plant. Male and sterile plants without midrib; male plants with scattered oval spore patches. Damaged plants may have bladelets growing from apex and margins. On stones in sand and mud, occasionally on bedrock, in areas with some tidal currents. Sublittoral. SW Britain, Ireland. (Young, sterile plants can be similar to *Rhodymenia pseudopalmata,* see 90 p. 22)

Stenogramme interrupta (*Fig. 16*)

— Midrib not interrupted; may be indistinct as a slightly raised, thickened, more opaque region in the centre of the frond 10

10(9) — Fronds soft, easily squashed. See 130 p. 27

Schmitzia hiscockiana (*Fig. 18*)

— Fronds cartilaginous to membranous, not squashy 11

11(10) — Smaller branches very regularly alternately arranged giving regular toothed outline. See 120 p. 26

Odonthalia dentata (*Fig. 18*)

— Plant irregularly branched or unbranched 12

12(11) — Plant usually profusely branched, to 20 cm long. 2–4 mm wide, cartilaginous, dark red. See 148 p. 30

Sphaerococcus coronopifolius (*Fig. 18*)

— Plant not profusely branched 13

13(12) — Frond tips pointed, plant thin (1 cell thick) and membranous with indistinct, thicker midrib. Very similar to *Polyneura gmelinii* (see Fig. 11) but narrower (to 1 cm wide) and without lateral macro- or microscopic veins. To 5 cm long. Doubtful occurrence in the British Isles; possibly S coast

Erythroglossum sandrianum (*Fig. 11*)

— Front tips rounded, plants tough 14

14(13) — Plant cartilaginous, holding shape out of water. 4–10 mm wide, to 15 cm long. Undivided or with several new blades growing from old parts or surface of midrib, narrowed and often thickened at insertion forming an indistinct midrib. Older parts often encrusted with animals. On vertical walls and other shady places; littoral to deep sublittoral

Phyllophora crispa (*Fig. 19*)

— Plant not cartilaginous, fleshy, not holding shape out of water. To 2 cm wide and 10 cm long, irregularly dichotomously lobed, with evanescent thickened midrib. Known in Britain from Channel Islands and Isles of Scilly; also from France. See Guiry and Irvine, 1974

Cryptonemia seminervis

GROUP A

15(2) — Frond with microscopic veins (just visible through hand lens against light); larger macroscopic veins present or absent  16

— Frond without microscopic veins, but vein-like thickenings present at base of frond  22

16(15) — Frond usually wider than long, divided distally into wide sections  17

— Frond usually much divided into long narrow sections  19

17(16) — Apices rounded,  plant variable in shape and amount of division. Often with ruffled edge; tetraspores in marginal processes, cystocarps scattered over frond. Often iridescent, occasionally with hooked branches (but see also *Acrosorium uncinatum* opposite). To 2.5 cm broad and 20 cm long. Lower littoral pools and sublittoral, on rock, kelp stipes and other algae. Common. Can be similar to *Polyneura* below 

Cryptopleura ramosa (*Fig. 11*)

— Apices pointed (look carefully)  18

18(17) — Spores in elongated patches along margins of frond, cystocarps scattered. Often with pointed marginal bladelets. To 10(20) cm long and broad. Lower littoral and sublittoral, especially near lower limits of foliose algae. Common 

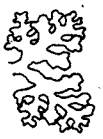
Polyneura gmelinii (*Fig. 11*)

— Spores in small patches over whole surface of frond. Not usually with marginal bladelets. Very difficult to separate from *P. gmelinii* when sterile. To 30 cm long and broad 

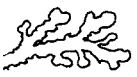
Polyneura hilliae (*Fig. 11*)

19(16) — Plant small (less than 5 cm), creeping, attached by root-like processes 20

— Plants to 20 cm, erect (perhaps a few creeping branches near base), no root-like processes 21

20(19) — Plant regularly branched, dichotomous or alternate, branch ends usually 2-lobed. Frond width not irregular. Root-like processes at regular intervals along frond edge. Rose to pale pink. Very thin. To 5 mm wide and 5 cm long. Sublittoral on pebbles, and bedrock in areas subject to winter scouring. SW Britain and Ireland 

Radicilingua thysanorhizans (*Fig. 11*)

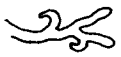
— Plant irregularly branched, occasionally dichotomous, apices rounded and lobed. Frond width irregular. Root-like processes from lower surface. Red to brownish-red. To 5 mm wide and 5 cm long. Lower littoral and sublittoral on kelp stipes and holdfasts, and other algae. Common but inconspicuous 

Acrosorium reptans (*Fig. 11*)

21(19) — Plants with macroscopic and microscopic veins. May sometimes have hooked branches and be difficult to distinguish from *Acrosorium uncinatum* below. See 17 above 

Cryptopleura ramosa (*Fig. 11*)

GROUP A

— Plants with microscopic veins, no macroscopic veins. Parts of frond modified into flattened marginal hooks.  Frond usually less than 5 mm wide, 

otherwise very similar to *Cryptopleura ramosa* above

Acrosorium uncinatum (*Fig. 11*)

22(15) — Smaller branches very regularly alternately arranged, giving a regularly toothed outline. See 120 p. 26 

Odonthalia dentata (*Fig. 18*)

— Branching not regularly alternate 23 

23(22) — Frond narrow, less than 3 mm, usually profusely branched with many small side-branches. See 148 p. 30

Sphaerococcus coronopifolius (*Fig. 18*)

— Frond usually wider than 3 mm. If narrower then without many small marginal proliferations 24

24(23) — Frond narrow, less than 5 mm (rarely to 1 cm), cartilaginous, not fleshy. Often of uneven width. See 14 p. 11 

Phyllophora crispa (*Fig. 19*)

— Frond wider than 4 mm, fleshy or membranous, not cartilaginous 25

25(24) — Blade divided into wedge-shaped sections not markedly narrowed on insertion. Membranous. To 20 cm long. See 63 p. 18 

Myriogramme bonnemaisonii (*Fig. 12*)

— Blade simple, or divided into sections markedly narrowed at insertion. Fleshy stipe often continuing into blade base as a thickening 26

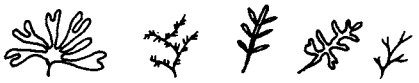
26(25) — Apices pointed, blades ovate, fleshy and elastic, simple or subdichotomously lobed, surface sometimes bullate, margins slightly thickened. No evanescent midrib. Blades to 60 cm long and 10 cm wide. Rose-red, cerise when dry. Rare. Sublittoral, Cork harbour, Ireland. See Guiry and Irvine (1974) 

Cryptonemia hibernica (*Fig. 15*)

— Apices not pointed, blades cuneate. Basal evanescent midrib. See 14 p. 11 and Guiry and Irvine (1974)

Cryptonemia seminervis

27(1) — Plants simple, split or lobed  28

— Plants variously branched (a wide range of branched forms exist; the illustrations are just a few examples)  56

GROUP A

28(27) — Margin saw-edged sometimes developing into long processes or bladelets, or notched 29

— Margin entire; undulate, split or lobed, not saw-edged or notched. May have secondary blades arising from margins 31

29(28) — Plants very soft and squashy, small (less than 3 cm), disc base. See 130 p. 27

Schmitzia hiscockiana (*Fig. 18*)

— Plants cartilaginous, to 30 cm long, branched holdfast  30

30(29), 143) — Blades to 7 cm wide, some marginal points developing into proliferations similar to parent blade, apices sometimes elongated into long processes rarely more than 5 mm long. Older plants also proliferous from the blade surface. Bright to dark red, to 30 cm long. Claw base. Usually sublittoral, sometimes forming dense stands on muddy rocks

Calliblepharis ciliata (*Fig. 22*)

— Blades usually less than 1 cm wide (to 1.5 cm). Sparingly to much branched. Marginal points later developing into long tendrils (to 30 mm) entwining other algae. Brownish red. To 30 cm long. Usually lower littoral, in pools. Can be mistaken for a brown seaweed

Calliblepharis jubata (*Fig. 22*)

31(28) — Frond relatively tough, leathery or cartilaginous particularly in older parts; if thinner then tough and opaque, not membranous. Not very elastic (see Glossary for definition of the terms used here) 32

— Frond very thin and membranous; if thicker then soft and gelatinous or very elastic 39

32(31) — Blade sections narrow, less than 1 cm 33

— Blade sections wide, more than 1 cm 36

33(32) — Plant not cartilaginous, floppy out of water but tough. To 20 cm, frond split into narrow wedge shaped sections. Lower shore rocks. Narrow form of this very variable species; see also 38 opposite

Palmaria palmata (*Fig. 17*)

— Plant cartilaginous, holding shape out of water 34

34(33) — Plants tiny, 1 cm (rarely to 3 cm) high, 1.5–3.5 mm wide, simple or divided once or twice. Characteristically with small oval proliferations from the margin; without these identification is difficult because of small size. Often many plants together in stands on bedrock and boulders. Littoral in shady pools, overhangs and caves; sublittoral

Phyllophora traillii (*Fig. 19*)

— Plants usually more than 2 cm high; more than 2 mm wide 35

GROUP A

35(34, 113,142) — Plant arising from stolons with short stipe expanding quickly into flattened blade, often slightly ruffled. No trace of midrib. Tetrasporangia in young plants in oval patches. Older plants may have apical and marginal stolons and be encrusted with animals. May be divided once or twice dichotomously or irregularly. To 10 cm long. Can be difficult to separate from *Phyllophora crispa* (see below and 14 p. 11) when young. Lower littoral and sublittoral. S and W coasts of Britain; Ireland

Schottera nicaeensis (*Fig. 19*)

— Plant arising from disc base; short stipe expanding gradually into thickened basal region or indistinct midrib. Margin often undulating. New growth narrowing markedly where it joins old parts. Reproductive organs in small lumpy outgrowths. To 15 cm. See also 14 p. 11

Phyllophora crispa (*Fig. 19*)

36(32) — Plants tough and leathery, up to 1 m thick. Blades wedge or spoon shaped, to 30 cm long and 20 cm wide, older blades split. Several fronds usually arising from the same base and tapering markedly towards base. Not proliferous from the margin. Dark red. Lower littoral and shallow sublittoral

Dilsea carnosa (*Fig. 14 & back cover plate*)

— Plants thinner; may be dark red and tough or cartilaginous in older parts, but new growth thinner and lighter in colour 37

37(36) — Frond sections wedge-shaped, older parts usually proliferous from the margin. Very variable in shape, size and number of divisions. Dark red to brownish. To 30 cm long. Lower littoral rocks, other algae and especially kelp stipes in shallow sublittoral. Common. See also 34 opposite

Palmaria palmata (*Fig. 17*)

— Frond simple, undulate or lobed, not wedge shaped 38

38(37) — Plants to 30 cm long and broad, younger parts soft and floppy, older parts may be cartilaginous and dark. May be simple and undivided, often broader than long, and/or with kidney-shaped lobes around margin. Cystocarps scattered over frond, numerous, less than 1 mm in diameter. Liver red to pink or greenish. Shallow sublittoral on rock

Kallymenia reniformis (*Fig. 14*)

— Plants to 4(8) cm, cartilaginous and bouncy, keeping shape out of water. Old basal parts dark liver red but new growth distinctive purplish pink when fresh (almost indistinguishable from *Kallymenia* above when dried, but older parts not adhering to paper). Margin entire or divided into a few undulating lobes. Cystocarps up to about 8 per plant, 1–2 mm in diameter. Shallow sublittoral, typically on vertical walls

Meredithia microphylla (*Fig. 14*).

39(31) — Texture membranous or like polythene, not gelatinous (see the Glossary for a fuller definition of the descriptive terms used here) 40

— Texture soft; gelatinous or fleshy 48

40(39) — Plants with conspicuous thick terete stipe to 4 cm long and thin blades dichotomously lobed distally. See 61 p. 18

Myriogramme heterocarpum (*Fig. 12*)

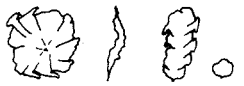
— Stipe small, flattened or absent 41

GROUP A

41(40) — Plant a thin sheet like polythene. Margin may be ruffled or split but no marginal proliferations, frond tips not dichotomous. No conspicuous spore patches 42

— Frond thicker, not like polythene, or if very thin then with spore patches or cystocarps scattered on frond 44

42(41) — Distal parts with apical points  or rounded. Often dichotomously divided sections; large-celled, cells just visible through × 10 hand lens 43

— Distal parts may be split, but no apical points or dichotomously divided sections; small-celled, individual cells not visible through hand lens. See accessory key on p 32 

Porphyra spp; Porphyropsis (*Fig. 13*)

43(42) — Plant to 3 cm high, usually wider than long, rare, sublittoral. See 67 p. 19 

Myriograme minuta (*Fig. 12*)

— Plant usually more than 3 cm (to 90 cm), longer than broad, simple or divided into narrow segments, often dichotomous. See 63 p. 18 

Nitophyllum punctatum (*Fig. 12*)

44(41) — Plants very thin, translucent 45

— Plants thin to fleshy, opaque 47

45(44) — Plants without spore patches, may have conspicuous cystocarps scattered on frond, or small proliferations from frond margins and surface. Blades a wide fan shape with wide tips (to 2 cm across tips), once or twice dichotomously lobed. Fronds to 10 cm long, several arising from small stipe. Large form of *Rhodophyllis,* possibly a separate species from *R. divaricata*. See also 68 p. 19 

Rhodophyllis sp (*Fig. 12*)

— Plants with spore patches, may be small 46

46(45) — Spore patches small, less than 1 mm, upper parts of frond only. See 67 p. 19 

Myriogramme minuta (*Fig. 12*)

— Spore patches more than 1 mm, conspicuous  63

47(44) — Plants membranous; crisp, thin, not fleshy. See 45 above 

Rhodophyllis sp (*Fig. 12*)

— Plants not membranous; floppy, thin to slightly fleshy. See 37 p. 15

Palmaria palmata (*Fig. 17*)

48(39) — Plants very soft and gelatinous, easily squashed between finger and thumb 49

— Plants soft but tough, not easily squashed 53

49(48, 59) — Plants small, less than 5 cm long 50

— Plants more than 5 cm long, to 30(50) cm 52

50(49) — Frond with notched margin. See 130 p. 27 
Schmitzia hiscockiana (*Fig. 18*)

— Margin not notched, plants dichotomously divided 51

51(50) — Frond flattened, delicate. See 52 below
young **Halarachnion ligulatum** (*Fig. 16*)

— Frond compressed, elastic, to 5 cm long and 2 mm broad. Rare, recorded in 1853 and not since. No habitat information available for the British Isles; elsewhere recorded from stones in lower littoral and sublittoral 
Platoma bairdii (*Fig. 16*)

52 (48,59) — Plant fairly delicate, not very elastic. Very variable shape, from undivided ribbons to much divided blades, usually flat but sometimes compressed. Often proliferous from margin and surface. Frond often covered with tiny dots (cystocarps). Can be similar to *Platoma marginifera* and *P. bairdii*; for internal differences see Dixon and Irvine (1977). To 50 cm × 20 cm. Sublittoral. Common 
Halarachnion ligulatum (*Fig. 16*)

Note. Very similar to undivided plants of *Halarachnion* but more elastic, is *Halymenia latifolia*, recently recorded from Co. Galway. See Maggs and Guiry, 1982b, and Fig. 13 of this key

— Plants fleshy, elastic, several blades arising from small disc base, to 25 cm long and 10 cm broad. Dichotomous or irregular, branch angles often keyhole shaped, surface sometimes with fleshy ridges extending inwards from thickened margin. Occasional proliferations from margin. Sublittoral and possibly lower littoral. Rare. Cornwall and SW Ireland 
Platoma marginifera (*Fig. 16*)

53(48) — Apices pointed (beware rounded fronds which have split) 54

— Apices rounded 55

54(53) — Blades lanceolate, long and narrow with markedly narrowed and pointed apices. Simple or with many secondary blades growing from primary blade, usually much narrower where they join the primary blade. 1–6 blades growing from the same base, up to 80(100) cm long and 20 cm broad. Dark red to crimson, often bleached at the tips. S coast, Solent area 
Grateloupia doryphora (*Fig. 15*)

— Blades ovate, apices pointed but not markedly narrowed. Blades simple or subdichotomously lobed, often several blades arising from the same short stipe. Surface sometimes bullate, often with thickened margins. To 60 cm long and 10 cm broad. Rose red. Sublittoral. Rare. Co. Cork, Ireland. See Guiry and Irvine (1974) see also 26, p. 13
Cryptonemia hibernica (*Fig. 15*)

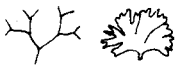
55(53) — Plants usually broader than long, young paler plants soft and fleshy, sometimes difficult to distinguish from *Schizymenia* below (see Dixon and Irvine, 1977). Older plants with dark cartilaginous parts near base and kidney-shaped lobes from frond margin. Sublittoral. See 38 p. 15 
Kallymenia reniformis (*Fig. 14*)

— Plants usually longer than broad, simple or split into long narrow sections, to 50 cm long and 20 cm broad, rarely with proliferations from the margin. Firmly mucilaginous, not cartilaginous, even in older parts. Brownish red. See Dixon and Irvine (1977) for separation from *Kallymenia*. Mid littoral pools to shallow sublittoral, on rock. S and W coast of Britain; Ireland 
Schizymenia dubyi (*Fig. 14*)

GROUP A

56(27) — Plants with swollen sacs  or articulated frond with swollen sections  156

— Plants without swollen sacs or articulations 57

57(56) — Plant regularly or irregularly dichotomous or fan shaped  58

— Plant not dichotomous or fan shaped 116

58(57) — Plants gelatinous, soft, easily squashed (see the Glossary for a fuller definition of the descriptive terms used here) 59

— Plant thin and membranous to thick and cartilaginous, but not easily squashed 60

59(58) — Plants small (less than 5 cm) and narrow (less than 5 mm) 50

— Plants larger, up to 30(50) cm long 52

60(58) — Plants very thin and membranous (1 or 2 cells thick) 61

— Plants cartilaginous, or if thin then tough and opaque (more than 2 cells thick) 81

61(60) — Plants with thick, terete stipe often left behind on collection. 1–4 cm long and broad. Bearing several thin fan shaped blades divided dichotomously into broad sections. In winter, frond tips form pale thickenings and may produce root-like structures. Reproductive structures unknown. To 10 cm. Blades crisp when fresh, quickly turning bright orange in fresh water—this colour change has been used as a diagnostic feature but many other species do this, although not usually as quickly. Sublittoral, common in deep water and in shady places in shallower water. Common in the SW; Ireland 

Myriogramme heterocarpum (*Fig. 12*)

— Stipe small, flattened or absent 62

62(61) — Conspicuous spore patches scattered over frond  63

— Spore patches absent or very small 64

63 (46, 62, 77, 80) — Spore patches ovoid, not markedly elongate.  Frond sections fan shaped, much divided distally, usually dichotomous, thickened slightly near base, margins often ruffled. Several fronds frequently growing from an older portion. To 15 cm long. Rose to pale pink. Lower shore and sublittoral into deep water, on kelp stipes, other algae and rock 

Myriogramme bonnemaisonii (*Fig. 12*)

— Spore patches elongate  ; fronds usually elongate and deeply divided into long narrow sections, usually dichotomous distally. Very variable in width and no. of divisions. To 90 cm long and 16 cm wide. Margins ruffled, often proliferous. Sublittoral on stones and algae 

Nitophyllum punctatum (*Fig. 12 & Plate 1b*)

64(62) — Plants with very small spore patches on upper frond. Less than 3 cm long. See 67 opposite 

Myriogramme minuta (*Fig. 12*)

— Plants without spore patches; reproductive structures if present in small bladelets on frond surface or margins 65

GROUP A

65(64) — Root-like outgrowths present at frond tips or margins  66

— Root-like outgrowths absent 69

66(65) — Frond tips thickened, often with root-like structures  . Stipe stout, terete, more than 1 cm long. Plants to 15 cm long. See 61 above 

Myriogramme heterocarpum (*Fig. 12*)

— Frond tips not thickened 67

67(66) — Stipe minute, up to a few mm long, inconspicuous. Plants less than 3 cm long, not deeply divided, pale pink. Single blade divided dichotomously distally into small sections, or almost entire. Cystocarps scattered, spores in sub-apical small patches. Winter plants may develop rhizoids from frond tips and margins. Sublittoral. Rare. SW Britain and Ireland 

Myriogramme minuta (*Fig. 12*)

— Stipe short (less than 1 cm), but stout. Plants to 10 cm high, usually deeply divided, dark red or rose, often bleached to pale brownish 68

68(67) — Blade 1 cell thick, cells visible with × 10 lens. With spectacular iridescence when young and underwater, iridescence lost in older plants. Dichotomous from a short stout stipe, blades recurving and attaching to substrate by root-like outgrowths from frond tips. Reproductive organs in small bladelets in winter, but not yet found in Britain. Dark rose to rosy-purple. Sublittoral on bedrock, sometimes forming extensive patches. S and W Britain, particularly common off the Pembrokeshire islands; Ireland 

Drachiella spectabilis (*Fig. 12 & Plate 1a*)

— Blade 2 cells thick, cells small, not visible with × 10 lens, not iridescent. Dichotomous, very variable in width and no. of divisions, from a profusely branched ball of fronds 2–5 mm in width to a wide form (see 45 p. 16) 4–5 cm in width. Often with surface and/or marginal proliferations and rhizoids. Lower littoral and sublittoral 

Rhodophyllis divaricata (*Fig. 11*)

69(65) — Proliferations from frond surface (but see also note on reproductive structures in *Drachiella*, 68 above). See 68 and 46 p. 16

Rhodophyllis sp (*Fig. 12*)

— No proliferations from frond surface 70

70(69) — Frond a wide fan shape, little divided at distal end  71

— Frond elongated  , wedge shaped  , or narrow  73

71(70) — Frond dark red to brownish red (may be bleached in summer to pale brownish or straw colour) 2 cells thick, cells small, not visible with × 10 lens. See 68 above and 46 p. 16 

Rhodophyllis sp (*Fig. 12*)

— Frond pale rose pink, 1 cell thick, cells larger—just visible with × 10 lens 72

72(71) — Stipe stout, to 4 cm long, bearing 1 to several blades. To 10 cm. See 61 p. 18 

Myriogramme heterocarpum (*Fig. 12*)

GROUP A

— Stipe narrow, small, to a few mm (but beware incomplete plants of *M. heterocarpum*), bearing a single blade. Plants small, to 3 cm. See 67 p. 19 

Myriogramme minuta (*Fig. 12*)

73(70) — Plants markedly elongate, to 30(90) cm. See 63 p. 19 

Nitophyllum punctatum (*Fig. 12*)

— Plants wedge shaped  , or segments narrow (less than 1 cm), plants less than 10 cm long 74

74(73) — Blades a wide wedge shape, dichotomously divided distally 75

— Blades less than 1 cm wide (microscope needed at next stage) 78

75(74) — Plant texture fleshy to thin, not crisp or membranous. Opaque. More than 1 cell thick. See 37 p. 15 

Palmaria palmata (*Fig. 17*)

— Plants membranous to crisp when fresh, not fleshy. Translucent to opaque, 1 cell thick 76

76(75) — Plants dark rose to red, young plants highly iridescent underwater. See 68 p. 19 

Drachiella spectabilis (*Fig. 12*)

— Plants rose to very pale 77

77(76) — Plants less than 3 cm wide when mature, usually broader than long. See 67 p. 19 

Myriogramme minuta (*Fig. 12*)

— Plants more than 3 cm when mature, usually longer than broad. Difficult to separate from each other when sterile 

63

78(74) — Plants more than 1 cell thick 79

— Plants 1 cell thick 80

79(78) — Plants fairly regularly dichotomous, frond sections strap-shaped. See 68 p. 19 

Rhodophyllis divaricata (*Fig. 11*)

— Plants irregularly divided at distal end, frond sections wedge shaped. See 37 p. 15 

Palmaria palmata (*Fig. 17*)

80(78) — Blades usually dark rose to red, young plants iridescent. Rhizoids from frond tips and margins. See 68 p. 19 

Drachiella spectabilis (*Fig. 12*)

— Blades rose to very pale pink, not iridescent. Two species very difficult to separate when sterile 63

GROUP A

81(60) — Frond inrolled longitudinally to form a gutter-like channel on one side. Plants often twisted, repeatedly dichotomous. Mature plants often with reproductive outgrowths on blade surface(s). Very dark in colour, reddish brown to black

To 10(17) cm. Lower littoral, often abundant; sublittoral fringe and occasionally in deeper water

Mastocarpus stellatus (= **Gigartina stellata**) (*Fig. 20 & Plate 2a*)

— Frond not channelled 82

82(81) — Blade sections wedge shaped 83

— Blade sections parallel-sided 102

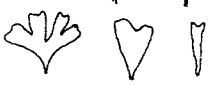
83(82) — Plants very brittle, cartilaginous, translucent, dull purple or reddish brown. To 25 cm long. Short compressed stipe expanding into a blade to 1 mm or more thick, up to 1 cm across dichotomies. Branching narrow angled, up to 6 times di- or tri-chotomous. Cystocarps large bumps with a pore, scattered on frond. Upper sublittoral to 15 m; very restricted distribution—Cornwall, S Devon and Dorset

Gracilaria foliifera (*Fig. 17*)

— Plants not brittle 84

84(83) — Stipe conspicuous, terete or flattened 85

Stipe inconspicuous or absent 91



85(84) — Mature plants very small (less than 2 cm), thin, narrow (less than 2 mm). Fronds arising from disc or stolons, stipe long or short (to 1 cm). Fronds simple to several times dichotomous, rose red to purplish, often in stands on boulders and bedrock. Can be confused with *Phyllophora traillii* (see 34 p. 14) (the latter usually bright red to brownish); for anatomical differences see Guiry (1977). Littoral in pools, and sublittoral. Probably widely distributed but very inconspicuous

Rhodymenia delicatula (*Fig. 19*)

— Plants more than 2 cm long when mature; not very thin 86

86(85) — Stipe flattened 87

— Stipe terete. 88

Note. Next 4 species difficult—see Dixon & Irvine (1977) and Guiry (1977)

87(86) — Frond regularly dichotomous, cartilaginous, often iridescent, little to much divided, to 10(22) cm long. Very variable width between individual plants, 2–15 mm. Dark reddish brown to purplish. Cystocarps large, concavo-convex; spore patches oval or linear. May be confused with *Mastocarpus stellatus* (= *Gigartina stellata*), *Gymnogongrus crenulatus* and *Phyllophora pseudoceranoides* (q.v.). For anatomical differences see Dixon and Irvine (1977). Littoral pools and rocks; sublittoral to 24 m

Chondrus crispus (*Fig. 20 & Plate 2b*)

— Frond irregularly dichotomous, floppy. Not iridescent. Cystocarps absent. See 37 p. 15

Palmaria palmata (*Fig. 17*)

GROUP A

88(86) — Flattened parts simple or only once or twice divided  89

— Flattened parts much divided into wide fan shape  90

89(88,137) — Basal disc more than 1 cm diameter, several blades arising from same base. Abrupt transition from stipe to blade, stipe often bent or varying in diameter, sometimes divided. Bright red. To 7 cm. Tetraspores in small patch in centre of blade. May be confused with *P. truncata* (below), *Schottera nicaeensis* (35 p. 15) and *Rhodymenia pseudopalmata* (90 below). See Dixon and Irvine (1977). On rock. Littoral in pools, sublittoral to 15 m. SW Britain, Cork 

Phyllophora sicula (*Fig. 19*)

— Basal disc small, gradual transition from stipe to blade. Stipe of uniform diameter and usually branched. Blades often with proliferations. Bright red, older parts darker. To 15 cm. Reproductive organs in outgrowths 1–2 mm diameter near apices. Lower littoral in pools; sublittoral to at least 10 m. Northern distribution, reaching southern limits at Anglesey and Northumberland; in Ireland S to Kerry 

Phyllophora truncata (*Fig. 19*)

90(88) — Stipe usually long (to 5 cm), often divided, expanding into a broad fan shaped blade, relatively thin, purplish to brownish red. Reproductive organs in small bladelets fringing upper parts, or spherical, 1–2 mm, on short stalk. To 10 cm. A diminutive form without a stipe also exists, see 98, opposite. Lower littoral pools; sublittoral to 12 m, particularly common in the sublittoral fringe 

Phyllophora pseudoceranoides (*Fig. 19*)

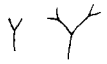
— Stipe usually short, less than 2 cm (rarely up to 4 cm), usually undivided. Blade relatively thick, red when young, becoming brownish later. Spores in patches near the apices, cystocarps small protuberances on frond. Plants to 12 cm long. A distinct form with markedly pointed apices keys out at 94, below. Lower littoral pools and sublittoral on rock and kelp stipes 

Rhodymenia pseudopalmata (*Fig. 19*)

91(84) — Frond sections wedge-shaped, usually proliferous from the margin. Very variable in shape, size and number of divisions. Dark red to brownish. To 30 cm long. Lower littoral rocks, other algae and especially kelp sites in shallow sublittoral. Common. See also 37 p. 15 

Palmaria palmata (*Fig. 17*)

— Not as above 92

92(91) — Frond little divided, 0–2 dichotomies  93

— Frond much divided, 3 or more dichotomies  97

93(92) — Apices sharply pointed 94

— Apices blunt 95

94(93) — Plants thick, gelatinous, compressed, dark red-brown. Two 4(7) cm. Usually only 1 or 2 dichotomies, but more luxuriant plants occur outside the British Isles. Frond tips sharply pointed but not drawn out. Superficially like small *Chondrus* but *Chondrus* is more flattened and not gelatinous. Lower littoral and sublittoral to 10 m, often near sand. SW Britain, N to Lundy 

Grateloupia dichotoma (*Fig. 16*)

GROUP A

— Plants thinner, cartilaginous, not gelatinous, flattened, red to brownish. To 5 cm. Fronds growing outwards from central short stipe, and recurving towards substrate. Dichotomies often widely divergent; frond tips long and pointed. Possibly a separate entity; at present included in *Rhodymenia pseudopalmata* (see 90 opposite). Distribution of this entity uncertain but common in SW Britain in deep sublittoral, and shady situations in the shallow sublittoral

'spiky' form of **Rhodymenia pseudopalmata** (*Fig. 19*)

95(93) — Plants 1–2 cm high when mature, blade sections less than 3 mm wide. See 85 p. 21

Rhodymenia delicatula (*Fig. 19*)

— Plants more than 2 cm high when mature 96

96(95) — Fronds of even width in undamaged plants, flat, usually regularly dichotomous. See 9 p. 11

Stenogramme interrupta (*Fig. 16*)

— Fronds of uneven width, undulate, irregularly dichotomous. See 14 p. 11

Phyllophora crispa (*Fig. 19*)

97(92) — Plants small, usually less than 3 cm 98

— Mature plants more than 3 cm 99

98(97) — Plants bright red, soft. To 3 cm. Much divided into broad fan shaped sections, much narrower at tips. Smaller divisions alternate, margins often proliferous. On stipes and holdfasts of kelp. Northern species, S to Northumberland

Callophyllis cristata (*Fig. 18*)

— Plants purple-pink to brownish red, thin, not soft. To 3 cm. Much divided into broad fan-shaped sections, dichotomous throughout. Frond tips not markedly narrowed. Diminutive and distinctive form of this species. No information on distribution but occurs in SW Britain, lower littoral pools and sublittoral fringe. See also 90 opposite

diminutive form of **Phyllophora pseudoceranoides** (*Fig. 19*)

99(97) — Plants soft, fleshy, often with tiny marginal leaflets 100

— Plants cartilaginous, margin entire except for occasional proliferation after damage 101

100(99) — Fronds bright red (darker in older parts), usually much divided into broad fan-shaped sections, further divided at distal end. Reproductive organs in tiny bladelets fringing the margins. Lower littoral and shallow sublittoral, on rock and kelp stipes and holdfasts. Common

Callophyllis laciniata (*Fig. 17*)

— Thallus dark red throughout, deeply divided into narrow (7–12 mm) strap-like sections with further dichotomies. Reproductive organs fringing margins in tiny leaflets. Sublittoral. Rare. S coast

Callophyllis flabellata (*Fig. 17*)

GROUP A

101(99, 114) — Plants with very short terete stipe, blades rose to pale pink or brownish. Easy to separate when fertile (see 9 p. 11), but can be difficult to distinguish from *Rhodymenia pseudopalmata* when sterile—see Dixon and Irvine (1977)

Stenogramme interrupta (*Fig. 16*)

— Plants with short to long (to 3 cm) terete stipe, blades red to brownish. See 90 p. 22 and 94 p. 22

Rhodymenia pseudopalmata (*Fig. 19*)

102(82) — Width of blades usually less than 2 mm 103

— Width of blades usually more than 2 mm 108

103(102) — Plants much branched, irregularly dichotomous  or subdichotomous,  smaller branches sometimes alternate  104

— Plants sparsely branched with few (up to 4) dichotomies  105

104(103, 121,146) — Cystocarps on outer edges of smaller branches, surrounded by a few short ramuli  Apices of ramuli sometimes bifid and hooked inwards. Plants 2.5–10 cm. Rare

Microcladia glandulosa (*Fig. 21*)

— Cystocarps in mid-frond. Apices not hooked inwards. Plants to 10–20 cm, rather flaccid. On kelp stipes. Northern species, sporadic occurrence. Rare. Beware *Membranoptera alata* (see 7 p. 10) with lamina worn away in winter—usually some fragments of lamina or side-veins left in specimens of the latter

Pantoneura angustissima (*Fig. 10*)

105(103) — Frond thin and flat, plants 1–2 cm long, rose-red to purplish. See 85 p. 21

Rhodymenia delicatula (*Fig. 19*)

— Frond not thin, compressed, cartilaginous or gelatinous 106

106(105) — Plants cartilaginous, not gelatinous, fronds almost terete below to compressed above. To 15 cm long. Dark reddish or brownish purple; branching to 4 times dichotomous. Branches usually in 1 plane but axes twisted. Cystocarps spherical to 3 mm diameter, in special short branches. Lower littoral and upper sublittoral, tolerant of sand cover. SW Britain, S Ireland

Gigartina pistillata (*Fig. 20*)

— Plants somewhat gelatinous; no special reproductive branchlets. Usually less than 4 cm (to 7 cm) 107

107(106) — Frond very narrow, usually less than 1 mm wide. Branching from a few dichotomies to much branched, irregular or pinnate. Smaller lateral branches often curved downwards. Usually several plants growing from the same base, fronds dark brownish or greyish violet. Most British specimens less than 2 cm high to 7 cm. Lower littoral and sublittoral, often near sand. SW Britain, N to Anglesey, Ireland

Grateloupia filicina var. **filicina** (*Fig. 16*)

— Frond narrow at base broadening to 3 mm or more above. Little branched. See 94 p. 22

Grateloupia dichotoma (*Fig. 16*)

GROUP A

108(102) — Frond tips markedly pointed 109

— Frond tips rounded or squared (occasional long apical processes in *Schottera* and *Rhodymenia holmesii*) 111

109(108) — Plants compressed, gelatinous, few dichotomies. See 94 p. 22

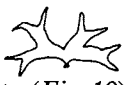
Grateloupia dichotoma (*Fig. 16*)

— Plants flattened, not gelatinous, 1–7 or more dichotomies 110

110(109) — Plants very dark brownish red. Plants growing erect; often with long flattened stipe. See 87 p. 21

Chondrus crispus (*Fig. 20*)

— Plants dark rose-red to brownish, growing from a small, stout terete central stipe and recurving to the substrate. See 94 p. 22



'spiky' form of **Rhodymenia pseudopalmata** (*Fig. 19*)

111(108) — Fronds arising from creeping stolons 112

— Fronds arising from disc holdfast 113

112(111) — Blades less than 4 mm wide, up to 5 times regularly dichotomously divided. Erect fronds arising from creeping stolons, with cylindrical stipes expanding gradually into strap-like blades often spirally twisted. Rose to dark red. Spores in patches near apices; cystocarps near base of frond. Apices occasionally drawn out into long processes. Sublittoral in deep water where dense stands may occur; in shallower water and lower littoral in shady places. S and W Britain, N to Pembrokeshire; Ireland

Rhodymenia holmesii (*Fig. 19*)
(= **Rhodymenia pseudopalmata** var **ellisiae**)

— Blades usually more than 5 mm wide, little divided, see 35 p. 15

Schottera nicaeensis (*Fig. 19*)

113(111) — Plants bright red to pink, older parts darker and often overgrown with animals. Little divided, often of irregular width 35

— Plants rose to brownish red to very dark. Usually regularly dichotomous. Frond width not usually irregular. The next 4 species difficult without reproductive structures; look at Figs. 16, 19 and 20 114

114(113) — Plants very dark brownish red to almost black 115

— Plants rose to brownish, not very dark except in old parts 101

115(113) — Plants dark brownish red with no hint of purple. To 10 cm. Stipe becoming flattened and expanding gradually into blade 2–4 mm broad; blades of even width in same plant, nor narrowing markedly at tips. Characteristic squared appearance to frond tips. Somewhat crenulate and twisted on its axis. Repeatedly (to 7 times) dichotomous. Never iridescent. Reproductive organs dark lumps on surface. Littoral in pools, sublittoral to 13 m. Often near sand. S and W Britain, S and W Ireland

Gymnogongrus crenulatus (*Fig. 20*)

GROUP A

— Plants dark brownish red to purplish or almost black. To 22 cm. Width of blades variable from plant to plant, 1–2 mm to more than 1 cm. Often much narrower at tips. Flat, not crenulate, often iridescent. See 87 p. 21

Chondrus crispus (*Fig. 20*)

116(57) — Smallest branchlets comblike  , on alternating series of 3–6 branchlets each side, in very characteristic pattern. Plants dark to rose red; fronds to 3 mm wide, 2–15 cm long. Reproductive organs up to 1 mm diameter on frond margins or small branchlets. Usually flattened in one plane but may become bushy, especially when fertile. A diminutive form also exists. Lower littoral pools and sublittoral, on kelp stipes and rock to 30 m

Plocamium cartilagineum (*Fig. 18*)

— Branchlets not comblike, plants not as above 117

117(116) — Branching regularly alternate  118

— Branching not regularly alternate 122

118(117) — Plants small (less than 3 cm), main axis simple or branched only a few times, clothed with regularly alternate, pinnate, short, spine-like ramuli. Erect fronds arising from a creeping axis. Littoral and sublittoral, often on sand-covered rocks. S and W coasts, N to Pembroke; Ireland

Pterosiphonia pennata (*Fig. 29*)

— Plants with variously branched main axis; smaller branches alternate 119

119(118) — Smaller branches blunt ended, fronds thick and fleshy. Purplish red to olive, bleached to yellow in summer. Variable in form from large (to 20 cm), scraggy and much branched in rock pools to short and stubby on exposed shores, sometimes forming a turf. Littoral and sublittoral fringe, occasionally in deeper water

Laurencia pinnatifida (*Fig. 22*)

— Apices narrow and pointed, plants not thick and fleshy 120

120(119) — Frond 2–6 cm across sections, regularly alternately notched with sharply pointed apices. Frond thickened in centre forming a midrib in older parts. Reproductive bodies tufted on frond. Dark red. Lower littoral and sublittoral. Northern distribution, Scotland, N England and Ireland S to Co. Mayo

Odonthalia dentata (*Fig. 18*)

— Frond less than 2 mm across main axes 121

121(120) — Ramuli close-set, short and spine-like. Plants dark red, black on drying. To 15 cm long. Lower littoral and sublittoral fringe. S and SW coasts of Britain and Ireland

Pterosiphonia complanata (*Fig. 29*)

— Ramuli irregularly alternate or subdichotomous, not close-set  104

122(117) — All or most branches opposite  123

— Branching not opposite 127

123(122) — Plants terete below, tips flattened. See 149 p. 30 

Gelidium pusillum (*Fig. 21*)

— Plants flattened throughout 124

GROUP A

124(123) — Branches markedly narrowed at insertion  125

— Branches not narrowed at insertion  151

125(124) — Plants cartilaginous, red to purplish or almost black, to 30 cm. Prostrate terete axes giving rise to erect fronds. Lower parts flattened, to 4 mm wide, tips cylindrical in spring becoming flattened later. Branching variable, pinnate, usually forming a frond with triangular outline. Lower littoral pools and sublittoral fringe. S and W coasts of Britain and Ireland 

Pterocladia capillacea (*Fig. 29*)

— Plants soft and floppy, rose pink to pale brownish red 126

126(125, 130) — Plants small, less than 3 cm, soft, little branched into oval sections. May grow long processes in low light. Lower littoral and sublittoral into deep water 

Lomentaria orcadensis (*Fig. 22*)

— Plants to 10–15 cm, usually much branched pinnately, branchlets narrow and elongate—exposed shore form. Plants growing in shelter and sublittorally usually branched more luxuriantly and all round main axes (see 131 below) 

Lomentaria clavellosa (*Fig. 22*)

127(122) — Plants soft and squashy (see the Glossary for a fuller definition of the descriptive terms used here) 128

— Plants cartilaginous or membranous 134

128(127) — Plants small, less than 3 cm when mature 129

— Plants larger than 3 cm 131

129(128) — Plants with creeping and recurving axes, constricted at intervals into small segments, much branched irregularly. Some segments terete, come flattened. To 2 cm high. Common on upper and middle sheltered shores, often mixed with (and confused with) *Gelidium pusillum* (see 149 p. 30) 

Catenella caespitosa (*Fig. 23*)

— Plants without creeping axes (except occasionally under low light conditions) 130

130(129) — Plants with very soft unbranched frond 5 mm–1 cm wide, with distinctive notched edge; to 3 cm long. Frond thickened in centre near base forming an indistinct midrib. Pale pink. In groups on boulders in very exposed situations. Sublittoral to 12 m, Lundy, Pembrokeshire, the Hebrides and Galway. A recently described species; see Maggs and Guiry (1985) 

Schmitzia hiscockiana (*Fig. 18*)

— Plants branched, branches narrowed at insertion  126

131(128) — Main axis narrow (less than 2 mm wide, up to 30 cm long) usually profusely branched with many short side branches narrowed at insertion. Lower littoral pools and sublittoral, sheltered sites on stones in sand and mud. Also an exposed littoral form, see 126 above 

Lomentaria clavellosa (*Fig. 22*)

— Main axis usually wider than 2 mm; to 5–6 cm wide 132

GROUP A

132(131) — Frond thin and relatively delicate, somewhat gelatinous when fresh. See 52 p. 17

Halarachnion ligulatum (*Fig. 16*)

— Frond fleshy, gelatinous 133

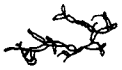
133(132) — Frond 2–10 mm wide, to 70 cm long, narrowed at base and apex, main axis simple or with side branches of variable length. Often with spiny protuberances and small branches from margins and surface of frond. Sporelings terete, flattened later. S coast, localised

Grateloupia filicina var. **luxurians** (*Fig. 15*)

— Frond to 10 cm wide and 24 cm long, elastic, marginal and surface proliferations only occasional. See 52 p. 17

Platoma marginifera (*Fig. 16*)

134(127) — Plants narrow, (less than 1 mm), markedly constricted at intervals. Small and creeping. See 129 p. 27



Catenella caespitosa (*Fig. 23*)

— Plants not markedly constricted, not as above 135

135(134) — Margin entire (except for proliferations after damage) 136

— Margin notched, or plant with many side branches, pinnate or irregular 143

136(135) — Stipe prominent, terete

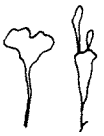
137

— Stipe small or absent 138

137(136) — Stipe a few mm to 1 cm, arising from prostrate terete axes. Blades thin, elongate, simple or with a few divisions. Sometimes with long, terete apical processes. Blade usually slightly ruffled. See 35 p. 15

Schottera nicaeensis (*Fig. 19*)

— Stipe usually more than 1 cm, arising from disc base, usually branched. Blades simple or dichotomously lobed. May have further blades growing from apex. No terete apical processes. Blade usually flat



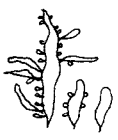
89

138(136) — Plants very brittle. See 83 p. 21

Gracilaria foliifera (*Fig. 17*)

— Plants not brittle 139

139(138) — Plants tiny, usually less than 1 cm, often with a few small marginal leaflets. See 35 p. 15



Phyllophora traillii (*Fig. 19*)

— Plants usually more than 2 cm long and 3 mm broad 140

GROUP A

140(139) — Fronds not cartilaginous, not holding shape out of water 141

— Fronds cartilaginous, bouncy, holding shape out of water 142

141(140) — Plants rose to pale brownish, usually less than 10 cm (to 15 cm). Usually dichotomous, but proliferating from apices and margins after damage. Easily distinguished when fertile; can be difficult when sterile. See 9 p. 11

Stenogramme interrupta (*Fig. 16*)

— Plants dark red to rose or brownish, usually more than 10 cm long (to 30 cm). Frond little to much divided into wedge-shaped sections. Often proliferous from margin. See 37 p. 15

Palmaria palmata (*Fig. 17*)

142(140) — Fronds flat, not ruffled, not of uneven width. See 9 p. 11 and 141 above

Stenogramme interrupta (*Fig. 16*)

— Fronds ruffled, often of uneven width 35

143(135) — Margin of frond notched, saw-like, later developing long terete processes or leaflets 30

— Margin not like saw edge 144

144(143) — Plants usually more than 1 cm wide, floppy, not cartilaginous. See 37 p. 15

Palmaria palmata (*Fig. 17*)

— Plants usually less than 1 cm wide; if wider then cartilaginous or thick and fleshy 145

145(144) — Plants less than 1 cm high (rarely to 2 cm), often with a few marginal leaflets. See 34 p. 14

Phyllophora traillii (*Fig. 19*)

— Plants not as *P. traillii* above 146

146(145) — Frond very narrow (less than 1 mm), not cartilaginous, red, irregularly alternate or subdichotomous

104

— Frond more than 1 mm wide, or if narrow then cartilaginous and dark red to very dark in colour 147

147(146) — Branches much narrowed at insertion. See 125 p. 27

Pterocladia capillacea (*Fig. 21*)

— Branches not much narrowed at insertion 148

Note. Identification is difficult from here on; check with Figs 18, 20 and 21

GROUP A

148(147) — Axis with central thickening in older parts forming an indistinct midrib. To 25 cm. Usually much branched, coarse below, more slender above. Upper branches often fringed with small ramuli which may contain spherical cystocarps. Upper branches often irregularly alternate or subdichotomous. Herringbone pattern visible on younger parts with × 10 lens. Older parts very tough and cartilaginous. Dark to bright red. Usually sublittoral, to 15 m. S and W Britain and Ireland

Sphaerococcus coronopifolius (*Fig. 18*)

— Axis without central thickening; plants not as above 149

149(148) — Plants very narrow (less than 1 mm) except at tips. Terete and flattened parts, tips may be expanded and up to 2 mm wide. Often almost black, and wiry. Usually with both creeping and erect axes. Branching variable, usually distichous but sometimes radial. To 15 cm high. On rock, mid to lower littoral, occasionally sublittoral fringe. Often mixed with (and confused with) *Catenella caespitosa* (see 129 p. 27). See also note at 150 below

Gelidium pusillum (*Fig. 21*)

— Plants more than 1 mm wide in main axes; flattened or compressed through most of plant 150

150(149) — Plants thin, flattened throughout 151

Note. Identification of *Gelidium* species is notoriously difficult because of lack of clear-cut distinguishing features and presence of intermediate forms. For more information see Dixon and Irvine, 1977

— Plants fleshy, compressed 152

151(124, 150) — Outline of frond irregular because of variable length of side branches. Plants with erect and creeping axes, 1–5 mm broad and up to 20 cm long. Branching distichous or radial. Colour variable. On rock. Lower littoral; sublittoral to 15 m

Gelidium latifolium (*Fig. 21*)

— Outline of frond parallel-sided, side branches of similar length. Erect fronds from creeping axes, 1–3 mm broad and up to 40 cm long. On rock. Sublittoral fringe in wave-exposed situations. Cornwall and Devon

Gelidium sesquipedale (*Fig. 21*)

152(150) — Frond tips sharply pointed 153

— Frond tips blunt 155

153(152) — Fronds often arching and reattaching to any substrate. Branching variable, pinnate or irregular, not usually luxuriantly branched. Some parts may be terete. Dark reddish purple, sometimes bleached. Very springy. To 12 cm long. Lower littoral and shallow sublittoral, often near sand or mud. S and W coasts of Britain, northwards to Pembrokeshire; S and W Ireland

Gigartina acicularis (*Fig. 20*)

— Fronds not reattaching to substrate. Branching pinnate, with many small side branches 154

154(153) — Branches and branchlets set almost at right angles. Main axes to 5 mm broad, closely set with small pinnate branches, simple or further divided, inserted pinnately but projecting at all angles. Red-purple, often bleached. On rock in sheltered areas, lower littoral and upper sublittoral to 6 m. Rare. Cornwall, S Devon, Pembrokeshire, SW Ireland

Gigartina teedii (*Fig. 20*)

— Branches and branchlets set at a 45° angle. Main axes to 2 mm broad, set with pinnate spine-like branches, the whole plant with flattened habit. Under the microscope, a fishbone pattern similar to *Sphaerococcus* (148 opposite) may be visible in youngest parts. On rock at exposed sites, often forming dense cover, in the sublittoral fringe. Recently discovered in the Scillies (Maggs, 1986); also from Japan and W America. (For further information on structure, see Abbott and Hollenberg, 1976)

Pikea californica (*Fig. 21*)

155(152) — Plants with disc base, fleshy, not very brittle. Dark purple-red, bleached in summer to yellow. Branch ends wide and very blunt; smaller branches often alternate and angled upwards. Forms a short turf on exposed lower littoral rocks, larger in shelter and in rock pools (to 20 cm). See also 119 p. 26

Laurencia pinnatifida (*Fig. 11*)

— Plants with creeping base, fleshy but very brittle, plant goes off quickly after collection. Rose-red. Branch ends blunt, but smaller branches may be slender, branching open-angled. Usually littoral, in lower shore sandy lagoons. Cornwall and SW Ireland

Laurencia platycephala (*Fig. 22*)

156(56) — Plants with inflated sacs in bunches or singly at or near the ends of the plant. Main axis terete or slightly compressed, < 1 mm wide, dichotomous. To 10(25) cm long, brownish red or bleached to yellowish. On rock, lower littoral and sublittoral fringe. Locally common, especially in the SW

Gastroclonium ovatum (*Fig. 23*)

— Plants with articulated, swollen sections 157

157(156) — Constrictions at regular intervals along main axes, main axes more than 1 mm wide, plants not creeping, red. See Group B, p. 33

Lomentaria articulata (*Fig. 23*)

— Constrictions at irregular intervals, main axes usually less than 1 mm wide, plants creeping, very dark. See 129 p. 27

Catenella caespitosa (*Fig. 23*)

KEY TO **Porphyra** AND **Porphyropsis**

1 — Holdfast central. Olive to purple-brown, may be bleached to light brown. To 10(20) cm long. Texture like polythene bag. Rocky littoral, occasionally sublittoral
Porphyra umbilicalis (*Fig. 13*)

— Holdfast basal 2

2(1) — Plants small and narrow, usually less than 1 cm wide and 10 cm long, strap shaped, often split. Seasonal (late winter and spring) forming a narrow band on upper littoral rocks (see Fig. 7)
Porphyra linearis (*Fig. 13*)

— Plants not a narrow strap shape; if less than 1 cm wide then round or oval in shape 3

3(2) — Plants very small (6 mm—4 cm diameter), violet-red to pale violet. Originally a hollow ball, later splitting to form an oval or roundish frond. Cells much smaller than *Porphyra*. Sublittoral, on rock and other algae. N and W coasts.
Porphyropsis coccinea (*Fig. 13*)

— Plants usually more than 4 cm long 4

4(3) — Fronds purple-black or brownish, usually very dark but sometimes paler, elongated, tough. To 40 cm long and 5 cm wide. Common, on littoral rock near sand. Eaten as laver bread in S Wales and Eire
Porphyra purpurea (*Fig. 13*)

— Fronds pink to violet, or if brownish then very pale (identification difficult from here on) 5

5(4) — Plant 2 cell layers thick, rose-purple to red, 15–30 cm broad and to 100 cm or more long. Northern species
Porphyra miniata (*Fig. 13*)

— Plant 1 cell layer thick, oval or elongate 6

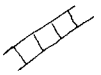
6(5) — Plants tough, amethyst-coloured, sublittoral. Northern species
Porphyra amethystea

— Plants delicate, red-purple (pink on drying). Littoral and sublittoral. On other algae
Porphyra leucosticta (*Fig. 13*)

GROUP B

Plants with main axes and branches filiform. Without filamentous branches or markedly flattened parts.

1 — Main axis markedly constricted at intervals.  Constrictions easily visible without hand lens 2

— Main axis not markedly constricted at intervals (but may appear striped ) 10

2(1) — Plants very soft and gelatinous and slippery, easily squashed between finger and thumb, axes composed of loosely organised filaments. (The next 3 species difficult—if possible; squash part of main axis on a microscope slide under a coverslip and examine under high power.) Sublittoral on pebbles and stones which are stable in summer but scoured in winter, or in tidal streams 3

— Plants soft to firm, not easily squashed between finger and thumb, axes not composed of loosely organised filaments 4

3(2, 29) — Plants to 30 cm, much branched. Crimson to pale pink. Main axis not monosiphonous, with whorls of many dichotomous ramuli. Young plant very similar to *Calosiphonia* and *Schmitzia neapolitana* below. Sublittoral, on pebbles and stones which are stable in summer but scoured in winter, or in tidal streams

Dudresnaya verticillata (*Fig. 24*)

— Plants to 10 cm, little to much branched. Pale crimson to pale pink. Main axis monosiphonous with whorls of 3 or 4 dichotomous ramuli. Sublittoral on stones stable in summer but scoured in winter. Southwest Britain. Two closely similar species; there is still some confusion over identification of British specimens. For a detailed study of French plants see Feldmann (1954)

Calosiphonia vermicularis and **Schmitzia neapolitana** (*Fig. 24*)

4(2) — Constrictions at irregular intervals along main axes. Segments very variable in size and shape, plants small (few cm high) and creeping. Much branched irregularly, some segments flat, some cylindrical. Common in upper and middle sheltered littoral, often mixed with *Gelidium pusillum* (see Group A, 149, p. 30)

Catenella caespitosa (*Fig. 23*)

— Constrictions at regular intervals along main axes, plants not as above 5

5(4) — Segments pear or bone shaped  . Plants much branched dichotomously, to 20 cm, soft to firm, turgid. Lower littoral and sublittoral, on stones, sheltered sandy and muddy areas, particularly estuaries

Griffithsia corallinoides (*Fig. 33*)

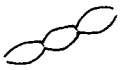
— Segments oval  or cylindrical  6

6(5) — Plants creeping, to 3 cm high and 7 cm long. Axes recurved and attaching to substrate by small discs. Dark or dull red, or bleached, sometimes iridescent. Lower littoral rocks and pools, shallow sublittoral. Local occurrence, S and SW Britain, S and W Ireland

Gastroclonium reflexum (*Fig. 23*)

— Plants erect. To 30(50) cm long. Occasionally with a few creeping branches near base. Usually much branched 7

GROUP B

7(6) — Segments elongated (much longer than broad), deeply constricted  8

— Segments not elongated (approximately as long as broad), not deeply constricted.  9

8(7) — Branching whorled at almost every node on main axis; branches ending with a row of articulations without whorls. Segments of main axis usually much elongated. Red, but often bleached to pale yellow or brownish. Middle and lower shore pools and shallow sublittoral, often on stones. (A very densely branched form may be a separate species, *Chylocladia squarrosa*) 

Chylocladia verticillata (*Fig. 23*)

— Branching often dichotomous in main branches, smaller branches whorled or opposite. Side branches extending off the nodes right to the last articulations of main axes. Bright red, occasionally bleached. Middle and lower shore under other algae and overhangs; sublittoral fringe. Common 

Lomentaria articulata (*Fig. 23*)

9(7) — Plants small, less than 5(10) cm long, soft and gelatinous. Segments short, well defined. Branching variable. Plants pink to dull red, on other algae, lower shore pools and sublittoral fringe. Not common. SW Britain and Ireland 

Champia parvula (*Fig. 23*)

— Plants often more than 10 cm long, firm to cartilaginous although young plants may be slippery 20

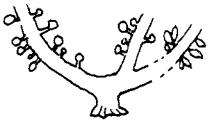
10(1) — Plant with sacs at branch tips, or prominent stalked reproductive organs. Unbranched or sparsely branched, no small ramuli, axis 1–5 mm thick  11

— Plant without sacs; if large stalked reproductive organs present then plant much branched or with small ramuli 13

11(10) — Plants with sacs in bunches at frond tips. Branched base. To 10(25) cm long, brownish red, often bleached to yellowish. On rock, lower littoral and sublittoral fringe. Locally common 

Gastroclonium ovatum (*Fig. 23*)

— Plants with stalked reproductive organs 12

12(11) — Colour red to pink, 3–5 cm thick, terete or slightly compressed, unbranched or once or twice irregularly branched. Cystocarps spherical, single, stalked, to 2 mm across; tetraspores in small flattened leaflets to 2 mm across. Reproductive organs usually in 1 or 2 rows. Winter *Delesseria sanguinea*, with blade worn away (see Group A, 8 p. 10 and Figs. 4 and 10) 

Delesseria sanguinea (*Fig. 10 & front cover plate*)

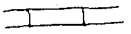
— Colour dark reddish or brownish purple, terete below, compressed above, to 2–3 mm wide and 20 cm long. Dichotomous (to 4 times). Cystocarps to 3 mm across, singly or several together on smaller branches. Rare, SW Britain, S Ireland 

Gigartina pistillata (*Fig. 20*)

13(10) — Branching regularly or irregularly dichotomous  or subdichotomous  (see Glossary) 14

— Branching various, not dichotomous; or unbranched 24

GROUP B

14(13) — Axis consisting of a single row of large cells often visible to the naked eye  15

— Axis not a single row of cells 16

15(14) — Apices very narrow and pointed Bright red. To 20 cm. Usually much branched at a narrow angle. Occasionally with a few pale, creeping branches. Reproductive organs on special small branches surrounded by tiny incurved ramuli (see Fig. 4). Littoral in pools and shallow sublittoral. Common 

Griffithsia flosculosa (*Fig. 33*)

Apices blunt  plants otherwise very similar to *Griffithsia flosculosa* above but with axes somewhat wider and often curved over. Extreme lower littoral and shallow sublittoral. Very rare, S England

Bornetia secundiflora (*Fig. 33*)

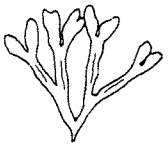
18(14) — Plants (1)2–4 mm wide, soft and turgid 17

— Plants usually less than 2 mm wide; if wider then cartilaginous, not soft 18

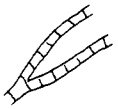
17(16) — ***Note.*** The following characteristics often, but not always, reliable—for microscopic differences and distribution see Maggs and Guiry, 1982a

— Fronds 1–2(3) mm wide, brownish or dull red. To 10 cm high. Central filaments not usually visible in pressed specimens. Upper sublittoral, on stones and boulders. S and W Britain, northwards to Pembroke; S Ireland 

Scinaia forcellata subsp **forcellata** (*Fig. 25*)

— Fronds 2–4 mm wide, pinky red. To 15 cm high. Very turgid. Central filaments usually visible in pressed specimens. Sublittoral to 30 m, on stones and shells in sand and mud; also in tidal currents. S and W Britain northwards to the Hebrides; Ireland 

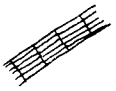
Scinaia turgida (*Fig. 25*)

18(16) — Frond striped across (use hand lens)  19

— Frond not striped 20

19(18) — Axis consisting of a single row of cells, with bands of smaller cells at nodes,  or complete covering of corticating cells. See key to *Ceramium* spp. p. 63

Ceramium sp (*Fig. 32*)

— Axis polysiphonous  See key to *Polysiphonia* spp. p. 58

Polysiphonia sp (*Figs 31 and 32*)

20(18) — Plants less than 0.5 mm wide and 5 cm long. Terete, stiff and cartilaginous. Regularly dichotomous, forming a tuft. Apices often slightly flattened. Lower littoral, on rock and in pools, upper sublittoral, tolerant of sand cover. S and W coasts of Britain, N to Argyll; Ireland 

Gymnogongrus griffithsiae (*Fig. 25*)

— Plants usually more than 0·5 mm wide; not as *Gymnogongrus griffithsiae* above 21

GROUP B

21(20) — Plants deep red, usually compressed, much branched, irregularly dichotomous or subdichotomous. Tufted at ends; cystocarps on the outer edges of smaller branches, surrounded by a few short ramuli  Apices of ramuli sometimes bifid and hooked. To 10 cm. Rare 

Microcladia glandulosa (*Fig. 21*)

— Plants very dark red to black, main branching regularly dichotomous. Terete or slightly compressed  22

22(21) — Plants terete below, often compressed above. Branching up to 4 times dichotomous in 1 plane but axes often twisted. To 15 cm long and 2–3 mm wide. Cystocarps spherical, to 3 mm diameter, in special short branchlets. Tetrasporangia in irregular patches near apices. Lower littoral and upper sublittoral, tolerant of sand cover 

Gigartina pistillata (*Fig. 20*)

— Plants terete throughout, branching not in 1 plane 23

23(22) — Plants with claw holdfast  . Brownish when held against the light. Reproductive organs in swollen apical regions. Apices tapering gradually, not paler. Fronds tufted, to 30 cm long and 1–2 mm thick. On rock, lower littoral and sublittoral to 12 m, tolerant of sand cover 

Furcellaria lumbricalis (*Fig. 25*)

— Plants with disc holdfast  . Reddish when held against the light. Reproductive organs in lumps on one side of the frond. Apices tapering abruptly, often paler at the tips. Otherwise very similar to *Furcellaria* above in appearance and habitat 

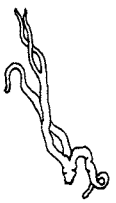
Polyides rotundus (*Fig. 25 & Plate 3b*)

24(13) — Plants gelatinous, very soft and slippery, wormlike 25

— Plants not very gelatinous and slippery when mature 35

25(24) — Plants sparsely branched 26

— Plants much branched 29

26(25) — Mature frond solid, to 10(25) cm long and 5 mm wide. Unbranched or branched a few times. Reddish brown or purplish, very slippery and elastic. On rock, limpets and barnacles, mid to lower littoral, in summer. (Young *Helminthocladia calvadosii* can be very similar, but usually with at least a few side-branches which are much narrower than the main axis. Also usually sublittoral, to 5 m) 

Nemalion helminthoides (*Fig. 24*)

— All or part of mature frond hollow (cut a cross section of the main axis or a larger branch—see the introductory notes) 27

27(26) — Plants tubular throughout, 1–10 mm broad, dark reddish or purplish brown to pale yellow. Membranous outside, gelatinous within. Conspicuous main axis with a few laterals which may themselves bear similar branchlets, but not clothed with small ramuli. Branches narrowed on joining main axis. Very variable in size, to 50 cm. Sometimes curled and twisted. On exposed shores plants only a few cm long with downcurved branches. Mid and lower littoral, on rock, and stones in sand. Common 

Dumontia contorta (=**D. incrassata**) (*Fig. 15*)

GROUP B

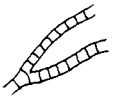
— Plant tubular in older parts, young parts solid. Very gelatinous and wormlike. The next two species can be difficult to separate 28

28(27) — Smaller branches not narrowed at base and apex (see 34 overleaf) 

Helminthocladia calvadosii (*Fig. 24*)

— Smaller branches narrowed at base and apex (see 33 below) 

Gloiosiphonia capillaris (*Fig. 24*)

29(25) — Axis striped or slightly constricted at regular intervals  3

— Axis not striped  30

30(29) — Smaller branches filamentous (less than 0.5 mm diameter) 31

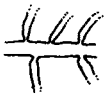
— Smaller branches filiform (more than 0.5 mm diameter) 32

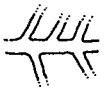
31(30) — Plants small. To 5(10) cm. Red. Branches wide spreading. Sublittoral to 20 m on coralline algae. Rare. Microscope needed to confirm—See Dixon and Irvine (1977). SW Britain, to Isle of Man 

Atractophora hypnoides (*Fig. 30*)

— Plants to 25 cm. Pink or red, long main axes clothed with short side branches arranged in a spiral. Cystocarps to 1 mm forming lumps in the smaller branches. Not difficult to recognise when fertile, otherwise microscope needed to confirm—see Dixon and Irvine (1977). Local, S and W Britain, S and W Ireland 

Naccaria wiggii (*Fig. 30*)

32(30) — Smaller branches constricted at insertion  33

— Smaller branches not constricted at insertion  34

33(32) — Plants soft, not gelatinous. Smallest branches often pinnate, alternate or opposite. Ramuli sac-like, slender but not markedly attenuate at apex. Branching variable in density so that main axis is almost naked, or the whole frond a matted ball. Cystocarps with an apical pore, sessile on the branches. To 40 cm. Exposed shore form flattened, pinnate, to 10 cm—see Fig. 22. Lower littoral and sublittoral on stones and other algae. Common 

Lomentaria clavellosa (*Fig. 22*)

— Plants firm to gelatinous. Branches all round main axis, bearing numerous small ramuli; branches and ramuli all attenuate at apex. Frond tubular in older parts. Cystocarps internal, distorting smallest branches. Lower littoral pools and sublittoral. Sporadic occurrence 

Gloiosiphonia capillaris (*Fig. 24*)

34(32) — Branches and main axes of similar thickness, 0.1–3 mm, plants to 25 cm. Usually profusely branched, becoming firm with age. Lower littoral pools and sublittoral to 30 m, on stones, gravel, shells and coralline algae 

Helminthora divaricata (*Fig. 24*)

GROUP B

— Branches usually much thinner than main axes. Main axis 2–5 mm diameter, becoming hollow and distorted with age. Young plants unbranched or with only a few small ramuli. To 40 cm. Sublittoral to 5 m, on rock

Helminthocladia calvadosii (*Fig. 24*)

35(24) — Plants hollow throughout (cut a cross section of the main axis or larger branch—see introductory notes), membranous outside, gelatinous inside. See 27 above

Dumontia contorta (*Fig. 15*)

— Plants solid 36

36(35) — Plants unbranched or branched only a few times 37

Note. Some species of filiform/filamentous red algae may key out here after storm damage or grazing by animals. These unfortunately are largely beyond the scope of this key, as microscopic features are needed for identification

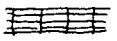
— Plants variously branched 40

37(36) — Plants usually more than 10 cm long, elastic. Cystocarps large bumps on one side of frond. See 58 p. 40

Gracilaria verrucosa (*Fig. 27*)

— Plants usually less than 10 cm, frond not elastic 38

38(37) — Fronds polysiphonous (stripes visible across frond under hand lens). See *Polysiphonia* key, p. 58



Polysiphonia sp (*Figs 31 and 32*)

— Frond not striped 39

39(38) — Plants bright to dull red. Several to many branches arising from an expanded disc base, unbranched or divided a few times irregularly. Reproductive organs in expanded tips. To 10 cm. Sublittoral (rarely littoral, in pools), on rock, tolerant of sand cover

Cordylecladia erecta (*Fig. 25*)

— Plants dull brownish red to yellowish. To 15 cm. Irregularly or dichotomously divided. Lower littoral and shallow sublittoral. *Gastroclonium ovatum* without sacs. See 11 p. 34

Gastroclonium ovatum (*Fig. 23*)

40(36) — Frond narrow, 0.5 mm or less, wiry, black (sometimes dark red or bleached to yellowish) 41

— Fronds not black and wiry 43

41(40) — Main axis long, to 20 cm, clothed with few to many short ramuli of similar length. See also key to *Polysiphonia* spp. p. 58

Polysiphonia nigra (*Fig. 31*)

— Main axes irregularly branched, sometimes pinnate; smaller branches very variable in length 42

GROUP B

42(41) — Frond tips sometimes flattened, may be expanded up to 2 mm wide. Usually with both creeping and erect axes. To 10 cm high. Branching often pinnate. On rock, mid to lower littoral, occasionally shallow sublittoral. Often mixed with *Catenella caespitosa* (see 4 p. 33)

Gelidium pusillum (*Fig. 21*)

— Frond terete throughout, discoid holdfast, black frond bleached when buried in sand. Branching highly irregular, sometimes secund. To 15 cm long. Lower littoral on rock and in pools; sublittoral to 12 m. Tolerant of sand cover

Ahnfeltia plicata (*Fig. 25*)

43(40) — Branch ends blunt and stubby: main axes with short side-branches

44

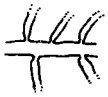
Branch ends not blunt

48

44(43) — Fronds solid, firm, cartilaginous or brittle. Branches not narrowed at insertion

45

— Fronds soft. Branches narrowed at insertion



46

45(44) — Plants dark purple to greenish yellow, not brittle. Branches alternate or opposite, cylindrical or slightly compressed. To 10(15) cm. On open rock, occasionally in pools, mid to lower littoral, often with *Laurencia pinnatifida*. Common

Laurencia hybrida (*Fig. 22*)

— Plants red, pink, purple or yellowish red, very brittle. Branches spiral and opposite, cylindrical. To 15 cm. Inshore littoral on other algae. Rare, local distribution

Laurencia obtusa (*Fig. 22*)

46(44) — Ramuli very numerous, often pinnate. Plants to 40 cm and profusely branched. Not dark in colour. See 33 p. 37

Lomentaria clavellosa (*Fig. 22*)

— Ramuli sparse to many, set all round axis. Plants not profusely branched. Usually dark red in colour, sometimes pink

47

47(46) — Frond brownish red to dark pink, very dark when dry, not iridescent. Ramuli short, straight to slightly curved. Common. Sublittoral on stones in sand and mud

Chondria dasyphylla (*Fig. 23*)

— Frond bluish or yellowish with blue iridescence, black when dry. Ramuli linear, often long and curved. Rare. Sussex, Suffolk, Hants

Chondria caerulescens

48(43) — Smallest branches numerous, comb-like, usually in pairs on the inner sides of main branches. Plants very bushy, main branching alternate or irregular. Dark red, cartilaginous and tough, rigid when dry. Ramuli sometimes with hooked apices. To 25 cm. Lower littoral pools and sublittoral, on rock, locally common. S coast of England, W Ireland

Halopitys incurvus (*Fig. 26*)

— Branching not comb-like

49

GROUP B

49(48) — Frond appears banded when viewed under a hand lens 50

— Frond not banded when viewed under a hand lens 51

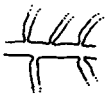
50(49) — Branching irregular, usually with well-marked main axis. Branches naked during winter, clothed in spring with numerous ramuli, narrowed at base and apex. Older parts dark and cartilaginous, younger parts bright red and gelatinous. To 30 cm. Lower shore pools and sublittoral to 15 m, on rock, stones and shells. Common. See also key to *Polysiphonia* spp. p. 58

Polysiphonia elongata (*Fig. 31*)

— Branching dichotomous in younger parts, older parts may be irregular. Main axes naked or clothed with short ramuli, simple or forked, sometimes with apices hooked inwards. To 20(30) cm. Littoral and sublittoral, most habitats. Common

Ceramium rubrum (*Fig. 32*)

51(49) — Plants with undivided short ramuli much narrowed at insertion



52

— Ramuli not narrowed at insertion, or plants without ramuli

53

52(51) — Plants with several long main axes, and side branches, narrowing markedly near apices. Axes clothed with few to many ramuli, narrowed at insertion and with apices drawn out into long processes. To 15(25) cm. Red to pink. Rare. Sublittoral, rarely littoral

Chondria tenuissima (*Fig. 23*)

— Plants usually profusely branched with many ramuli, often pinnate. Ramuli not drawn out into slender processes. See 33 p. 37

Lomentaria clavellosa (*Fig. 22*)

53(51) — Plants narrow (to 2 mm). Red. Much branched, irregularly alternate or subdichotomous, tufted at ends. Terete to compressed. To 10 cm long. Rare

Microcladia glandulosa (*Fig. 21*)

— Plants not branched irregularly alternately or subdichotomously 54

54(53) — Fronds very brittle. Bright to dark red, may be black on drying. 3 closely similar species:

Gracilaria bursa-pastoris: similar to *Gracilaria verrucosa* (see 58 opposite) but brighter red and brittle, not elastic. Dried specimens difficult to distinguish. Upper sublittoral, on rock, sheltered sites near sand. Local; S coast between Cornwall and Sussex, S and W Ireland (Fig. 27)

Solieria chordalis: for structural differences from *Gracilaria* see Dixon and Irvine (1977). Shallow sublittoral, on stones in mud. Falmouth, Weymouth, Portland and Milford Haven (see Farnham, 1980; *Solieria tenera* from Milford Haven probably referable to *S. chordalis*—P. Gabrielson, personal communication to L. M. Irvine). (Fig. 27 & Plate 3a)

Agardhiella subulata: very similar to *Gracilaria bursa-pastoris* but differing in internal structure (see Farnham, 1980; as *Neoagardhiella gaudichaudii*). Solent

— Fronds not brittle; colours various 55

GROUP B

55(54) — Plants less than 10 cm, much branched, reattaching to substrate. Frond 1–2 mm wide, terete to compressed, apices very pointed. Dark reddish purple, often bleached. Very springy. Lower littoral and upper sublittoral, tolerant of sand cover. S and SW coasts of Britain and Ireland

Gigartina acicularis (*Fig. 20*)

— Plants usually more than 10 cm; not reattaching to substrate 56

56(55) — Plants soft, 2–10 mm wide, to 70 cm long. Young plants terete, becoming flattened later. Original shoot producing similar laterals, later bearing short protuberances on margins and surface. Shallow sublittoral. Local. S coast of England

Grateloupia filicina var. **luxurians** (*Fig. 15*)

— Plants cartilaginous and firm 57

57(56) — Plant with branched holdfast, large (to 60 cm long and 2 mm wide) and usually profusely branched, but may lose many branchlets in the drift and become straggly. Dull brownish red or purplish. Branches attenuate at apices; occasionally with spirally twisted branchlets which entangle other algae. Cystocarps in swellings distorting smaller branches. Midlittoral to sublittoral. Common

Cystoclonium purpureum (*Fig. 26*)

— Plants with disc holdfast; cystocarps not embedded in smaller branches 58

58(57) — Fronds very elastic, dark brownish purple to greenish, branching variable, long and straggly or much branched and bushy, sometimes secund. To 60 cm long and 1–3 mm wide. Cystocarps external, large (to 1 mm) with pore, sessile on the lower parts of the plant. Sheltered sites, lower littoral and sublittoral to 15 m, sometimes loose lying. Tolerant of sand cover. Common

Gracilaria verrucosa (*Fig. 27*)

— Fronds not elastic 59

59(58) — Branches narrowed at base and apex. Frond banded (under hand lens) in upper part; ramuli elongate. See *Polysiphonia* key, p. 58

Polysiphonia elongata (*Fig. 31*)

— Branches not narrowed at base. Plants to 20(60) cm. Extremely variable in form depending on habitat, time of year and reproductive state. See notes below

Rhodomela spp (*Fig. 26*)

Two species are described in Parke and Dixon (1976)—*R. confervoides* and *R. lycopodioides*. Some east coast plants closely resemble *R. virgata* (see Fig. 26b, and illustration in Kronmann and Sahling, 1977, p. 255). It is possible that a gradation exists between these three entities.

Rhodomela confervoides: Sublittoral plants (see Fig. 26a and b) red. To 30 cm long. Main axis to 1.5 mm wide. Cartilaginous. Not usually densely branched. Ramuli short and spinelike, clothed in winter with stalked, tufted reproductive organs. On rock and kelp stipes, into deep water. Common

Littoral plants (Fig. 26c) more finely and densely branched, softer, clothed with ramuli, often tufted at the apices. Reproductive structures at apices and lateral. Plants red to brownish. In shallow pools, middle and lower littoral, tolerant of sand cover. Common. Fig. 26b shows the form of plants closely similar to *R. virgata*, from the E coast of England.

Rhodomela lycopodioides: (see Fig. 26d and e). Plants purplish brown. To 60 cm. Cartilaginous in winter, soft in summer. Main axes usually very densely clothed with short ramuli, some further developed and divided into tufts. Sublittoral, often on kelp stipes. Northern distribution; Scotland, N England and Ireland.

GROUP C

Main axes filiform, ramuli filamentous

1 — A few branches modified into hooks  or barbs  . Entangled with other algae, no holdfast 2

— No hooked or barbed branches 3

2(1) — Plant with hooked branches. Deep red to blackish. Much branched. To 20 cm. Shallow sublittoral, hooked onto other algae. S and W Britain, N to Argyll; Ireland 

Bonnemaisonia hamifera (*Fig. 28*)

— Plant with barbed branches. Rose pink, yellowish or whitish. To 30 cm. Axes naked in lower parts, densely tufted above. Shallow sublittoral, entangled with other algae. S and W Britain, S and W Ireland 

Asparagopsis armata (*Fig. 28*)

3(1) — Ramuli whorled  4

— Ramuli not arranged in whorls 5

4(3) — Whorls of ramuli close-packed, short, incurved, plant like dark red bottle brush. To 20 cm. Lower littoral and sublittoral fringe, on rock. Locally common 

Halurus equisetifolius (*Fig. 29*)

— Whorls of ramuli widely separated, ramuli fine, short or sometimes elongated and hairlike. Rose red to pale. Crisp when fresh but soon becoming flaccid. To 20 cm. Shady lower littoral pools and sublittoral. S and SW coasts 

Sphondylothamnion multifidum (*Fig. 29*)

5(3) — Smaller branches and ramuli always opposite (look carefully—pairs of ramuli may have one long and one very short partner)  6

— Ramuli not regularly opposite 8

6(5) — Ramuli unbranched, each pair with one long and 1 short partner, alternating with next pair. Plants bright red to pale purple, usually much branched. To 40 cm. Male reproductive organs small, ovoid; female organs spherical, visible to the naked eye. Male and female organs on the same plant. Common, sublittoral to 15 m 

Bonnemaisonia asparagoides (*Fig. 28*)

Note. *Bonnemaisonia clavata* is indistinguishable when sterile; when fertile it has larger reproductive organs, with male and female on separate plants. Rare. Sublittoral. Cornwall

— Smaller branches and ramuli themselves branched 7

GROUP C

7(6) — Plants dark purplish or brownish red. Soft and flaccid. 5–10 cm long, much branched, tatty in older parts. Long and short branches not regularly alternate. Monosiphonous throughout, corticate below. Lower littoral, particularly on vertical rock and overhangs. Common

Plumaria elegans (*Fig. 29*)

— Plants dark full red, sometimes brownish. Cartilaginous and somewhat rigid when fresh. To 30 cm long. Irregularly branched; long and short branchlets regularly alternate. Axis monosiphonous with a cortical flange of cells. Sublittoral on kelp stipes. Common. Northern distribution; S to N Wales and N England; N, W and S Ireland to Co. Cork

Ptilota plumosa (*Fig. 29*)

8(5) — Plant branched in one plane so that plants appear flattened throughout 9

— Plant not appearing flattened, or flattened only at the tips 12

9(8) — Mature plants small, less than 3 cm. Main axis simple or branched only a few times, erect fronds from creeping axes. Ramuli very regularly alternate, short and spine-like. Lower littoral and sublittoral, often on sand-covered rocks. S and W coasts, N to Pembroke, W Ireland

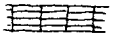
Pterosiphonia pennata (*Fig. 29*)

— Mature plants more than 3 cm, usually much branched 10

10(9) — Plants red when fresh (may be black on drying). Axes cylindrical or slightly compressed. Fronds with wide-spreading branches. Smaller branches with numerous tufted ramuli. Main branches polysiphonous, ramuli monosiphonous.

Tetraspores in stichidia  , cystocarps ovate.  To 20 cm. Common. Lower littoral pools and sublittoral

Heterosiphonia plumosa (*Fig. 30*)

— Plants dark red, black or dark brownish. Axes compressed. To 10(15) cm. Polysiphonous throughout  11

11(10) — Plants simple near base, much branched above, markedly flattened. Main axes with short, close-set, alternate, pinnate ramuli, further divided alternately. Older parts to 2 mm wide. Lower littoral and sublittoral fringe. S and SW coasts of Britain and Ireland. Local

Pterosiphonia complanata (*Fig. 29*)

— Plants branched from the base, from creeping axes. Main axis narrower than *P. complanata*, and not as flattened. Otherwise similar in form. Not common; easily confused with *Polysiphonia nigrescens*. See *Polysiphonia* key, p. 58

Pterosiphonia thuyoides (*Fig. 29*)

12(8) — Some apices markedly inrolled  13

— Apices straight, or only slightly curved (may have lateral ramuli curved around apex)  14

GROUP C

13(12) — Many ramuli near apex markedly inrolled around apex. Plants dark purplish or brownish. Main branching irregular, clothed with alternate branchlets with spine-like ramuli. To 5(10) cm. Upper muddy littoral, estuaries and salt marshes, entangled with other plants. Local. S and W Britain, Ireland

Bostrychia scorpioides (*Fig. 33*)

— Pairs of ramuli inrolled, giving forcipate appearance. See key to *Ceramium* spp, p. 63

Ceramium sp (*Fig. 32*)

14(12) — Plants with a long (to 30 cm) main axis, closely set with many long side branches, usually alternate. Side branches may bear a third series of similar branchlets, all branches densely clothed with tufts of small ramuli. Axes and branches polysiphonous, ramuli monosiphonous. Common. Lower littoral and sublittoral. See also *Polysiphonia* key p. 58

Brongniartella byssoides (*Fig. 30*)

Note. *Callithamnion tetragonum* can be similar to *B. byssoides* above, but lacks polysiphonous axes

— Plants not branched, as *Brongniartella* above 15

15(14) — Main axes up to 25 cm, irregularly branched, bearing many very fine hairlike ramuli all round axis (use lens or microscope on specimens in water). Ramuli not tufted 16

— Ramuli not hairlike; if very fine then borne in tufts 18

16(15) — Main axis cartilaginous, not gelatinous. Ramuli simple or occasionally divided; cystocarps surrounded by a few ramuli, not embedded. Lower littoral and sublittoral. Rare but locally frequent. S and SW England, W Ireland

Spyridia filamentosa (*Fig. 30*)

— Plants gelatinous throughout 17

17(16, 26) — Plants small. Red. To 5(10) cm, branches wide spreading. Ramuli whorled at apex (under high power). Sublittoral to 20 m on coralline algae. Rare. (Microscope needed to confirm; see Dixon and Irvine, 1977). SW Britain, to Isle of Man, S and W Ireland

Atractophora hypnoides (*Fig. 30*)

— Plants to 25 cm. Pink or red. Long main axes clothed with short side branches arranged in a spiral. Cystocarps to 1 mm forming lumps in the smaller branches. (Not too difficult to recognise when fertile, otherwise microscope needed to confirm; see Dixon and Irvine, 1977.) Local. S and W Britain; S Ireland

Naccaria wiggii (*Fig. 30*)

18(15) — Plants very bushy and spongy. Lower branches often naked, upper branches densely clothed with tufted ramuli, obscuring main axis. Ends of branches appearing very blunt. Dark red, purplish or brown. On rock and mussels, often associated with *Ceramium shuttleworthianum*; also in rock pools. Middle to lower littoral

Callithamnion spongiosum, C. granulatum and **C. sepositum** (*Fig. 34*) See Group D, part 2, 35

— Ramuli sparse, or if densely tufted then not with very blunt branch ends 19

GROUP C

19(18) — Plants black or very dark red when fresh 20

— Plants not black; red, pink or brownish (dried plants may be very dark) 23

20(19) — Ramuli sparse, branches little divided at distal end 21

— Ramuli numerous, branches much divided at distal end 22

21(20) — Ramuli tapering at base and apex, undivided, short; axes very narrow and wiry, plants very dark red to black. To 15(30) cm. Lower littoral and sublittoral, on rock and stones in sand and mud. Locally common. See *Polysiphonia* key, p. 58

Polysiphonia nigra (*Fig. 31*)

— Ramuli tapering sharply at apex, undivided or divided a few times. Plants much branched from the base, dark red. To 20 cm. Sublittoral. Not common. See *Polysiphonia* key, p. 58

Polysiphonia simulans (*Fig. 32*)

22(20) — Fronds arising several from the same base, elongate, to 15(30) cm long, scraggy below. Flattened above and regularly alternate. Middle and lower littoral. Common. See *Polysiphonia* key, p. 58

Polysiphonia nigrescens (*Fig. 31*)

— Plants with wide-spreading branches, not elongate. To 10 cm. Ramuli in tufts on lower branches, divergent  . Upper ramuli with flattened growth form, alternate or subdichotomous. Rare. Lower littoral and sublittoral, on rock, other algae and maerl. S coast of England; Galway. See *Polysiphonia* key p. 58

Polysiphonia foetidissima (*Fig. 32*)

23(19) — Fronds with flattened growth form at frond tips 24

— Fronds with branches all around main axis 26

24(23) — Branching usually dichotomous especially in younger parts; often with banded frond and/or forcipate apices. Structure monosiphonous with complete or incomplete cortication from the nodes. See *Ceramium* key, p. 63

Ceramium sp. (*Fig. 32*)

— Branching alternate, apices not forcipate  25

25(24) — Plants dark purplish brown, red in younger parts. To 15(30) cm. Polysiphonous throughout. See *Polysiphonia* key, p. 58

Polysiphonia nigrescens (*Fig. 31*)

— Plants red to brownish. Shaggy below with many small ramuli pressed close to main axis; flattened above and regularly alternately pinnate. Rather rigid and stiff to touch when fresh. Monosiphonous throughout; main axes corticate. Middle to lower littoral. Southern distribution

Callithamnion tetricum (*Fig. 34*)

26(23) — Plants very gelatinous throughout 17

— Plants soft to cartilaginous, not gelatinous 27

GROUP C

27(26) — Ramuli undivided 28

— Ramuli divided or tufted 30

28(27) — Plants pale pinkish purple. Softish. Ramuli narrowed at insertion and with apices drawn out into slender processes. Rock pools and sublittoral. Rare

Chondria tenuissima (*Fig. 23*)

— Plants bright red to very dark or brownish 29

29(28) — Usually dichotomous in younger parts, usually much divided. Axes naked or with many short ramuli. Structure monosiphonous with cortication at nodes , or over whole surfaces. See *Ceramium* key, p. 63

Ceramium sp (*Fig. 32*)

— Branches naked in winter, clothed in spring with many long ramuli, attenuate at base and apex. Younger branches bright red, older parts very dark. Branching irregular. To 30 cm. Structure polysiphonous. See *Polysiphonia* key, p. 58

Polysiphonia elongata (*Fig. 31*)

30(27) — Ramuli not tufted, spine-like, little divided alternately, set at a characteristically wide angle. Plants much branched and entangled. Fronds very springy. To 15 cm. Structure polysiphonous. Shallow pools, on other algae. S coast of England and Ireland. Local. See *Polysiphonia* key, p. 58

Polysiphonia fruticulosa (*Fig. 31*)

— Ramuli in tufts 31

31(30) — Ultimate ramuli very small, not easily seen even with hand lens 32

— Ultimate ramuli easily seen with hand lens 33

32(31) — Plants monosiphonous. Main axes surrounded by small tufts of ramuli; individual tufts easily seen. Branch ends pointed. To 10 cm. On other algae, particularly kelp fronds. See key D, part 2, 38

Callithamnion tetragonum (*Fig. 34*)

— Plants polysiphonous with monosiphonous ramuli. Lower axes sometimes naked, upper branches clothed with numerous tufts of ramuli. To 10 cm. *Dasya* spp—5 species difficult to separate unless fertile. The commonest is *Dasya hutchinsiae*. See *Polysiphonia* key, p. 58

Dasya sp (*Fig. 30*)

33(31) — Plants tough and cartilaginous. Usually much branched, often with many small branchlets around main axes and main branches, all cartilaginous. Reproductive organs in small tufted ramuli on the branches, lateral or at apices. To 60 cm long. Common. Lower littoral pools and sublittoral. See Group B, 59

Rhodomela sp (*Fig. 26*)

— Plants not cartilaginous. Long main axes, to 40 cm, clothed with sparse to dense tufts of ramuli, alternate or spiral. See *Polysiphonia* key, p. 58

Polysiphonia brodiaei (*Fig. 31*)

GROUP D—PART 1

Filamentous plants—brief key for use with ×10 hand lens (see note below). If a microscope is available go straight to part 2, p. 51

Many of the filamentous red algae are too small to be keyed out accurately without at least a low power dissecting microscope. However, some of the larger species have distinctive branching patterns or ramuli large enough to be easily seen with a ×10 hand lens. A brief key to these is given below. Identifications (except those marked with an asterisk) should be regarded as provisional and checked with the more detailed descriptions in part 2, and with the figures.

1 — Some branches modified into hooks  or barbs  2

— No hooked or barbed branches 3

2(1) — Plant with hooked branches. See Group D, part 2, 15 

***Bonnemaisonia hamifera** (*Fig. 28*)

— Plant with barbed branches. See Group D, part 2, 15 

***Asparagopsis armata** (*Fig. 28*)

3(1) — Plants unbranched, or branched only a few times 4

— Plants variously branched 5

4(3) — Forming a dense covering on open upper shore rock; gelatinous when wet, shiny when dry. See Group D, part 2, 10

Bangia atropurpurea

— Middle to lower shore, on rock, in pools or creeping in sand. See *Polysiphonia* key, p. 58
Polysiphonia macrocarpa—frequent
Lophosiphonia reptabunda—rare
Lophosiphonia subadunca—rare

5(3) — Smallest branches comblike,  in alternating groups of 2–6. See Group A, 116

***Plocamium cartilagineum** (*Fig. 18*)

— Branches not comblike 6

6(5) — Apices of some branches strongly inrolled  7

— Apices not strongly inrolled 8

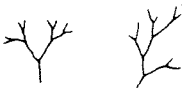
7(6) — Many ramuli inrolled all round apex. See part 2, 12. On salt marshes 

***Bostrychia scorpioides** (*Fig. 33*)

— Apices forcipate. See *Ceramium* key, p. 63. On rocky sea shores 

Ceramium spp (*Fig. 32*)

GROUP D1

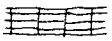
8(6) — Branching regularly dichotomous/subdichotomous  9

— Branching not regularly dichotomous 14

9(8) — Plants epiphytic on *Ascophyllum nodosum* (brown seaweed—see Hiscock, 1979). Dark purplish or brownish red tufts to 8 cm long. Common. Midlittoral. See key to *Polysiphonia* spp. p. 58
Polysiphonia lanosa (*Fig. 31*)

— Plants not epiphytic on *Ascophyllum nodosum* or *Fucus* spp 10

10(9) — Fronds monosiphonous; cells large, often visible to the naked eye; not obscured by a covering of smaller cells. Dichotomous/subdichotomous 11

— Fronds polysiphonous  , or monosiphonous with bands  or complete covering of small cells. Dichotomous 13

11(10) — Cells pear-shaped. See Group D, part 2, 47 

***Griffithsia corallinoides** (*Fig. 33*)

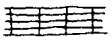
— Cells cylindrical or slightly swollen each end 12

12(11) — Apices attenuate. Common. See Group D, part 2, 49 

Griffithsia flosculosa (*Fig. 33*)

— Apices blunt. Rare. See Group D, part 2, 48 

Bornetia secundiflora (*Fig. 33*)

13(10) — Plant polysiphonous.  See key to *Polysiphonia* spp. p. 58

— Plants monosiphonous with bands  or complete covering of smaller cells. See key to *Ceramium* spp. p. 63

14(8) — Main axes with whorls of small ramuli  15

— Main axes without whorled ramuli 16

15(14) — Whorls close-set. Plant like dark red bottlebrush. See Group D, part 2, 18 

***Halurus equisetifolius** (*Fig. 29*)

— Whorls widely separated. Plants red to pale. Ramuli fine. See Group D, part 2, 21 

***Sphondylothamnion multifidum** (*Fig. 29*)

GROUP D1

16(14) — Ramuli opposite  17

— Ramuli not opposite 19

17(16) — Ramuli unbranched, each pair with one short and one long partner, alternating with the next pair. Plants bright red to purplish. To 40 cm. Sublittoral. See Group D, part 2, 26 

***Bonnemaisonia asparagoides** (*Fig. 28*)

— Ramuli and smaller branches themselves branched 18

18(17) — Plants purplish. Flaccid. Lower littoral pools and on vertical rocks. Widespread. See Group D, part 2, 27 

Plumaria elegans (*Fig. 29*)

— Plants bright to dark red. Somewhat rigid and cartilaginous, on kelp stipes. Northern distribution; S to N Wales; N and W Ireland. See Group D, part 2, 27 

Ptilota plumosa (*Fig. 29*)

19(16) — Plants flattened in form distally; very regularly alternate 20

— Plants not flattened; branched all around main axis 23

20(19) — Plants with simple or little-divided main axis, clothed with alternate short, undivided spinelike ramuli. S coasts. See *Polysiphonia* key p. 58 

Pterosiphonia pennata (*Fig. 29*)

— Plants usually much branched 21

21(20) — Plants very fine and fluffy, branch ends narrow and very regularly alternate, with zig-zag main axis. To 5(8) cm long. See Group D, part 2, 37. (Also *Callithamnion* spp) 

Compsothamnion thuyoides (*Fig. 34*)

— Plants not fluffy 22

22(21) — Plants usually less than 5 cm. Main axes narrow, clothed with alternate ramuli, becoming very small at branch ends. Lower branches often longer than upper, branches spreading. Lower littoral and sublittoral, particularly sublittoral fringe. See *Polysiphonia* key, p. 58 

Pterosiphonia parasitica (*Fig. 29*)

— Plants usually more than 5 cm. Main axes much thicker than ramuli in older parts. See *Polysiphonia* key, p. 58

Polysiphonia nigrescens (*Fig. 31*) and **Pterosiphonia thuyoides** (*Fig. 29*)

23(19) — Ramuli alternate 24

— Ramuli all round main axis; main branching may be alternate 25

GROUP D1

24(23) — Plants deep red. Common on lower shore and shallow sublittoral, on rock, limpets and other algae, particularly kelp stipes. See *Polysiphonia* key, p. 58 (also other *Polysiphonia* spp)

usually **Polysiphonia urceolata** (*Fig. 32*)

— Plants dark red, almost black. Ramuli tufted on lower axes, alternate above. Rare. Local; S coasts and Galway. See *Polysiphonia* key, p. 58

Polysiphonia foetidissima (*Fig. 32*)

25(23) — Plants small dense, fluffy balls, 2–3 cm diameter. On other algae. Shallow sublittoral. See *Polysiphonia* key, p. 58 and Group D, part 2, 51

'Falkenbergia' (tetrasporophyte) phase of **Asparagopsis armata** (*Fig. 28*)
'Trailliella' (tetrasporophyte) phase of **Bonnemaisonia hamifera** (*Fig. 28*)

— Plants not dense, fluffy balls 26

26(25) — Ramuli simple 27

— Ramuli tufted 30

27(26) — Texture gelatinous and slippery. See Group C, 17

Atractophora hypnoides (*Fig. 30*) and **Naccaria wiggii** (*Fig. 30*)

— Texture not gelatinous 28

28(27) — Ramuli very fine, hairlike, dense around upper main axes. See Group D, part 2, 32

Spyridia filamentosa (*Fig. 30*)

— Ramuli not fine and hairlike 29

29(28) — Colour red. Ramuli blunt ended. See Group D, part 2, 33

Corynospora pedicellata (*Fig. 33*)

— Colour black, or very dark red. Ramuli pointed. See *Polysiphonia* key, p. 58

Polysiphonia simulans and **P. nigra** (*Fig. 31*)

30(26) — Plants with long main axes (to 30 cm), may also have long side branches of similar length and usually opposite, all clothed with dense tufts of short ramuli. Lower littoral and sublittoral, usually on rock. Common. See *Polysiphonia* key, p. 58

Brongniartella byssoides (*Fig. 30*)

— Plants usually less than 10 cm 31

31(30) — Colour black. Not densely tufted. Coarse. See *Polysiphonia* key, p. 58

Polysiphonia foetidissima (*Fig. 32*)

— Colour red to dark red-brown, ramuli very fine, densely tufted 32

GROUP D1/D2

32(31) — Individual tufts of ramuli not easily seen, ramuli very dense, branches blunt ended. Plant spongy, holding water. Middle to lower littoral, on rock and mussels. See Group D, part 2, 35

***Callithamnion spongiosum, C. granulatum** and **C. sepositum** (*Fig. 34*)

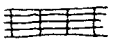
— Individual small tufts of ramuli easily seen, branch ends tapering. On other algae, particularly kelp stipes. See Group D, part 2, 38

Callithamnion tetragonum (*Fig. 34*)

GROUP D—PART 2

Filamentous plants—made up of individual fine hairs, finer than cotton thread.

Key for use with at least a × 20–40 dissecting microscope.

1 — Plants with polysiphonous main axis  , visible without sectioning at least in younger parts; may be obscured by a layer of small corticating cells in older parts. With or without monosiphonous ramuli. See *Polysiphonia* key, p. 58

— Plants without polysiphonous main axis 2

2(1) — Ramuli comblike,  on upper sides of smaller branches 3

— Ramuli not comblike 8

3(2) — Plants not monosiphonous. Frond flattened, branchlets comblike, arranged in alternating groups of up to 6 branchlets on each side. Diminutive form of *Plocamium cartilagineum*. See group A, 116

Plocamium cartilagineum (*Fig. 18*)

— Plants monosiphonous  , branchlets opposite  or whorled  4

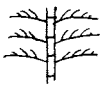
4(3) — Branchlets in whorls of 4, one opposite pair long, the other pair short. Spiny appearance. Ramuli comblike. Apices forcipate. Frond with regular outline. Not common

Antithamnion crispum (*Fig. 34*)

— Branchlets opposite or irregular 5

5(4) — Ramuli comblike throughout plant. Branchlets opposite. To 15 cm 6

— Ramuli comblike in upper parts only. To 3 cm 7



6(5) — Plants densely clothed with opposite branchlets with comblike ramuli. Markedly flattened. Main branching dichotomous to subdichotomous, apices with forcipate appearance. Plants red to brownish or bleached. To 15 cm. Lower littoral and sublittoral, on rock and other algae, particularly at muddy sites; locally frequent

Antithamnion plumula (*Fig. 34*)

— Branchlets sparse. Colour pink. Rare. N coasts

Antithamnion boreale

GROUP D2

7(5) — Lower ramuli opposite, upper ones secund. To 3 cm. Rare
Spermothamnion irregulare

— Lower branches irregular, upper ones pinnate. Ramuli secund. To 2 cm. Rare
Spermothamnion strictum

8(2) — Plants unbranched 9

— Plants branched 11

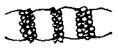
9(8) — Fronds consisting of a single row of cells. On various plant and animal hosts. Usually *Audouinella* spp—33 species in the Parke and Dixon (1976) checklist. Mostly very small, less than a few mm long. *A. floridula* forms dense mats on sandy rocks
Audouinella sp

— Fronds originally a single row of cells, but dividing later becoming multiseriate. Flat, tubular or filamentous 10

10(9) — Plants to 10(15) cm long. Dark blackish red or purple. Forming dense gelatinous (when wet) or shiny (when dry) covering on upper littoral rock and pier piles. Locally common

Bangia atropurpurea

— Plants less than 1 cm, *Erythrotrichia* spp
Flat: **Erythrotrichia boryana**
Tubular: **Erythrotrichia ciliaris**
Filamentous: **Erythrotrichia carnea, E. reflexa, E. investiens**

11(8) — Axes corticate at the nodes; monosiphonous with bands of small corticating cells at nodes  or covering main axes, giving striped appearance. Branching usually dichotomous or subdichotomous, sometimes with forcipate apices (but see also *Bostrychia scorpioides*, 12 below). With or without small spines. See key to *Ceramium*, p. 63

Ceramium sp (*Fig. 32*)

— Axes not corticate at the nodes (but may have downgrowing filaments from the nodes); ecorticate or with other types of cortication 12

12(11) — Ramuli at apices of main branches strongly inrolled. Plants dark purplish or brownish, main branching irregular, clothed with alternate branchlets with spine-like ramuli. To 5(10) cm. Upper muddy littoral sites, estuaries and saltmarshes, entangled with other plants. Local. S and W Britain; Ireland

Bostrychia scorpioides (*Fig. 33*)

— Apical ramuli not strongly inrolled (may be curved around reproductive organs on special branchlets, or around apices) 13

13(12) — Plants with well-marked main axis, clothed with sparse to dense short ramuli 14

— Plants without well marked main axis, variously branched; not clothed with short ramuli 43

14(13) — Plants with some branches modified as hooks  or barbs  15

— No hooked or barbed branches 16

15(14) — Plant with hooked branches. Deep red to blackish. Much branched. To 20 cm. Shallow sublittoral, hooked onto other algae. S and W Britain, N to Argyll; Ireland

Bonnemaisonia hamifera (*Fig. 28*)

GROUP D2

— Plant with barbed branches. Rose pink, yellowish or whitish. To 30 cm. Axes naked in lower parts, densely tufted above. Shallow sublittoral, entangled with other algae. S and W Britain; S and W Ireland 

Asparagopsis armata (*Fig. 28*)

16(14) — Ramuli or branchlets opposite or whorled on main axis  17

— Ramuli or branchlets alternate, dichotomous or irregular on main axis  31

17(16) — Ramuli in whorls  on main axis (sometimes in pairs and whorls on the same plant) 18

— Ramuli always opposite  on main axis 25

18(17) — Whorls close-set, ramuli dense. Plants like dark bottlebrush. To 20 cm. Lower littoral and sublittoral fringe, on rock. Locally frequent 

Halurus equisetifolius (*Fig. 29*)

— Plants red to pale. Delicate 19

19(18) — Ramuli simple  , or branched, opposite or irregular  20

— Ramuli dichotomous  21

20(19) — Ramuli simple. Plants to 4 cm. Very fine. On other algae, lower littoral and sublittoral. Common

Antithamnion spirographidis (*Fig. 34*)

— Ramuli branched, opposite or irregular. Few main branches, apices tufted. Plants to 5 cm. Very fine. Lower littoral and sublittoral, on muddy rocks

Antithamnion cruciatum (*Fig. 34*)

21(19) — Plants not gelatinous or slippery. Long main axes with whorls of ramuli widely separated, ramuli fine, short or sometimes long and hairlike. Rose red to pale. Crisp when fresh, soon becoming flaccid. To 20 m. Shady lower littoral pools and sublittoral. S and SW coasts 

Sphondylothamnion multifidum (*Fig. 29*)

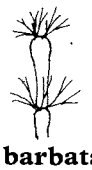
— Plants gelatinous or slippery 22

22(21) — Main axes repeatedly dichotomous, plants densely tufted. Monosiphonous, large-celled. Ramuli whorled 23

— Main axes irregularly branched 24

23(22) — Ramuli short, undivided; cells of main axis cylindrical or slightly broadened at each end. Plants to 8 cm. Sublittoral, muddy areas. Rare (local). S coast and Pembrokeshire 

Griffithsia devoniensis (*Fig. 33*)

— Ramuli long, dichotomously divided, very fine. Cells of main axis narrow, cylindrical or slightly swollen at upper end. To 7 cm. In pools, on other algae. Rare. S coast 

Griffithsia barbata

GROUP D2

24(22) — Whorls of ramuli over whole plant; individual whorls easily seen under low power microscope. Plants small, to 5 cm long. Delicate. Little to much branched. On other algae, lower littoral and sublittoral. S coasts

Crouania attenuata (*Fig. 34*)

— Whorls of ramuli visible only near apex, with high power microscope. Plants to 5(10) cm long. Delicate. Much branched, branches wide spreading. Sublittoral to 20 m on coralline algae. Rare. SW Britain, N to Isle of Man. See Dixon and Irvine (1977) for detailed description

Atractophora hypnoides (*Fig. 30*)

25(17) — Plants usually more than 5 cm long, to 40 cm. Main axes prominent and thicker than ramuli. If monosiphonous then corticate at least below 26

— Plants usually less than 5 cm (rarely to 10 cm). Main axes and ramuli very fine. Monosiphonous, ecorticate. Difficult group—reproductive features needed 28

26(25) — Ramuli unbranched, each pair with one long and one short partner, alternating with next pair. Plants bright red to purplish, usually much branched. To 40 cm. Male reproductive organs small, ovoid, female organs spherical, visible to the naked eye. Male and female organs on the same plant. Common, sublittoral to 15 m

Bonnemaisonia asparagoides (*Fig. 28*)

— ***Note.*** *Bonnemaisonia clavata* is indistinguishable when sterile; when fertile it has larger reproductive organs, with male and female on separate plants. Rare. Sublittoral. Cornwall

— Smaller branches and ramuli themselves branched; plants not as above 27

27(26) — Plants dark purplish or brownish red. Soft and flaccid. 5–10 cm long. Much branched, tatty in older parts. Long and short branches not regularly alternate. Monosiphonous throughout. Corticate below. Lower littoral, particularly overhangs and vertical rock. Common

Plumaria elegans (*Fig. 29*)

— Plants dark full red, sometimes brownish, cartilaginous and somewhat rigid when fresh. To 30 cm long, irregularly branched. Long and short branchlets regularly alternate. Axis monosiphonous with a cortical flange of cells. Sublittoral on kelp stipes. Common. Northern distribution, S to N Wales and N England; N and W Ireland

Ptilota plumosa (*Fig. 29*)

28(25) — Plants less than 2 cm high. Erect branches arising from creeping axes. Naked below, upper parts with closely pinnate, opposite, simple ramuli. Tetrasporangia terminal. On kelp stipes

Ptilothamnion pluma (*Fig. 34*)

— Plant usually more than 2 cm when mature 29

29(28) — Tetrasporangia cruciate  , terminal on ramuli  . Main branching alternate to irregular; whorl branchlets simple and tapered. To 10 cm. On rock. Rare. Orkney

Antithamnion floccosum

— Tetrasporangia tetrahedral  . To 5 cm. Branching not as above 30

30(29) — Ramuli simple, rarely alternately branched, elongate, spreading. On other algae. Common

Spermothamnion repens

— Branchlets simple or bearing closely pinnate, opposite, short spinelike ramuli; lower half sometimes naked. Dull brownish red. Somewhat rigid. On muddy rock. Rare. S coast

Spermothamnion irregulare

GROUP D2

31(16) — Ramuli set irregularly on main axis; ramuli simple or divided once or twice 32

— Ramuli set in various ways on main axis, not irregularly; ramuli branched alternately or dichotomously 35

32(31) — Ramuli very fine and hairlike, simple (occasionally divided). Main axis cartilaginous. Cystocarps surrounded by a few ramuli, not embedded. Lower littoral and sublittoral. Locally common. S and SW England

Spyridia filamentosa (*Fig. 30*)

— Ramuli not hairlike; plant not as above 33

33(32) — Ramuli blunt-ended, short, sparse to numerous, usually dichotomously divided into small tufts. Main branching very variable, plants with few main axes or densely tufted. Sometimes alternate near apices. Pinkish red. Crisp, soon becoming flaccid. Often with monospores. Lower littoral and sublittoral, sheltered (often muddy) sites

Corynospora pedicellata (*Fig. 33*)

— Ramuli tapered at ends. Plants gelatinous, not as above 34

34(33) — Plants small, at 5(10) cm. Red. Branches wide spreading. Small whorls visible near apices (under high power). Sublittoral to 20 m on coralline algae. Rare. See Dixon and Irvine (1977). SW Britain, to Isle of Man

Atractophora hypnoides (*Fig. 30*)

— Plants to 25 cm. Pink or red. Long main axes clothed with short ramuli arranged in a spiral. Cystocarps to 1 mm forming lumps in the smaller branches. Not too difficult to recognise when fertile, otherwise see Dixon and Irvine (1977)

Naccaria wiggii (*Fig. 30*)

35(31, 45) — Plants densely branched, very bushy and spongy, branch ends very blunt. To 15 cm. Lower branches often naked, upper branches densely clothed with tufted ramuli, often obscuring main axis. Dark red, purplish or brown. On rock and mussels, also in rock pools, middle to lower littoral. 3 closely similar species; the main characteristic for identification is the most usual number of cells in the ultimate lateral branches (Dixon and Price, 1981)

1–2 cells — **Callithamnion spongiosum**
3–4 cells — **Callithamnion granulatum**
7–9 cells — **Callithamnion sepositum** (= **C. arbuscula**) (*Fig. 34*)

— Plants sparsely to profusely branched; if profusely branched, then lax, not spongy 36

36(35) — Whole plant markedly flattened in form; axes often zig-zag 37

— Plant not flattened, or only at branch ends 38

37(36) — Outline of fronds very narrow, frond sections lanceolate. Very regularly alternate. Ecorticate. To 10 cm. Lower littoral and shallow sublittoral,

not uncommon, **Compsothamnion thuyoides** (*Fig. 34*)
rare, **Compsothamnion gracillimum**

— Outline of frond wider, not lanceolate. Usually with at least some cortication. Ramuli not usually overtopping main axes. To 10 cm. Lower littoral and shallow sublittoral. (Possibly also other *Callithamnion* spp—see Dixon and Price, 1981)

Callithamnion hookeri

GROUP D2

38(36) — Ramuli in many small tufts around main axes; tufts easily seen. Individual apical cells conical with a sharp point. Ramuli short. Branched from the base, few to many main branches but not usually profusely branched. To 11 cm. Red. (Small specimens of *Brongniartella byssoides* can be similar, but darker in colour and with polysiphonous main axes.) On other algae, especially kelp fronds

Callithamnion tetragonum (*Fig. 34*)

— Ramuli not tufted around main axes; plants not as above 39

39(38) — Plants with lower parts naked or sparsely branched, upper parts much branched, with pinnate ramuli near apices. Deep red, brownish near base. Rather rigid when fresh, soon becoming flaccid. To 12 cm. Lower littoral. Not common

Pleonosporium borreri (*Fig. 34*)

— Plants usually much branched from the base 40

40(39) — Lateral ramuli not usually overtopping main axes

41

— Lateral ramuli usually overtopping main axes

42

41(40) — Plants with ramuli pressed close to axis. To 10(20) cm. Rigid, harsh to touch. Red to brownish. Main axes and branches densely covered with short ramuli. Ramuli regularly alternate at branch ends, flattened in form. Rock pools and vertical rock, middle to lower littoral. Common. S and SW coasts of Britain, S and W Ireland

Callithamnion tetricum (*Fig. 34*)

— Plants without adpressed ramuli on main axes; may have few to many ramuli arising from cortication. See 37 above

Callithamnion hookeri

42(40) — Spores in branched chains; branches very fine. To 8 cm. Very similar to *Callithamnion byssoides* when sterile. Locally common, lower littoral and sublittoral, sheltered muddy sites

Seirospora seirosperma and **S. interrupta** (*Fig. 34*)

— Spores not in chains, or plants without spores. Sterile **Seirospora** and 'fluffy' **Callithamnion** spp—**C. hookeri, C. decompositum, C. corymbosum, C. roseum** and **C. byssoides.** See Dixon and Price (1981) for key to *Callithamnion* species and species descriptions

43(13) — Plants formed of fine filaments erect and creeping. To 1(2) cm. Alternately or dichotomously branched. Cells very small. Forming dense tufts or covering large areas on rock, trapping sand and silt. Common. Middle to lower littoral

Audouinella floridula

Note. There are many other species of *Audouinella* (33 in Parke and Dixon, 1977) growing on or in rock, shells, animals and other algae. Mainly less than a few mm long and beyond the scope of this key

— Plants not forming a dense mat binding sand on rock 44

44(43) — Branches and/or ramuli dichotomous

45

— Branches and/or ramuli not dichotomous 51

45(44) — Plants corticate 35

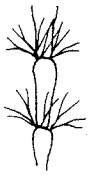
— Plants ecorticate 46

GROUP D2

46(45) — Cells pear-shaped  or bone-shaped  47

— Cells cylindrical or slightly swollen at each end  48

47(46) — Upper branches clothed at each node with whorls of long byssoid dichotomous ramuli, bearing tetraspores. Plants to 7 cm long. Rose-red. Tender and lubricous. Rare. In pools on other algae. S coast



Griffithsia barbata

— No whorls of dichotomous ramuli. Variable in size, up to 20 cm. Cells of main axis can be very wide; cells usually easily visible with the naked eye. Very turgid. Pear-shaped in the centre of the frond, may be cylindrical above and below. Locally frequent, especially in sheltered muddy areas. Lower littoral and shallow sublittoral

Griffithsia corallinoides (*Fig. 33*)

48(46) — Apices very blunt, easily seen as blunt without lens. Plants to 20 cm, crimson, gelatinous, much-branched and tufted, somewhat fan-shaped, branches often curved over. Rare, extreme lower littoral and shallow sublittoral, S Coast of Britain

Bornetia secundiflora (*Fig. 33*)

— Apices attenuate, or too fine to see without lens 49

49(48) — Plants to 20 cm. Red. Rigid and crisp when fresh. Reproductive organs on short lateral branches not arranged in whorls. Reproductive organs surrounded by short incurved ramuli. Apical cells pointed. Size and texture variable: from 10–20 cm for coarse plants to less than 4 cm and very fine. Sometimes with a few pale rhizoidal branches creeping in mud. Can become very tatty with many branches worn away, but easily recognisable by large cylindrical cells and bright red colour. Common

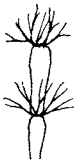
Griffithsia flosculosa (*Fig. 33*)

— Plants less than 10 cm. Fine and gelatinous. Reproductive organs on ramuli arranged in whorls at the nodes. Apical cells blunt 50

50(49) — Whorled ramuli, short, unbranched. Rare (locally common). Shallow sublittoral on mud. S coast, N to Pembrokeshire; S Ireland

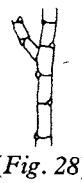
Griffithsia devoniensis (*Fig. 33*)

— Whorled ramuli long and byssoid, repeatedly dichotomous. Rare. In pools on smaller algae. S coast of Britain



Griffithsia barbata

51(44) — Small refractive cells present between cells of main axis. Plants made up of monosiphonous erect branches from creeping axes, irregularly branched to form a dense matted ball. On algae, occasionally on rock, lower littoral and sublittoral. Locally common. S and W Britain and Ireland, N to Shetland. Tetrasporangial phase of **Bonnemaisonia hamifera** (see 15 p. 52)



'Trailliella' (*Fig. 28*)

— Small refractive cells absent. Plant made up of single row of large, turgid, cylindrical cells. Bright red. See 49 above

Griffithsia flosculosa (*Fig. 33*)

POLY.

KEY TO **Polysiphonia** AND OTHER POLYSIPHONOUS SPECIES—**Pterosiphonia, Lophosiphonia, Brongniartella, Dasya, Heterosiphonia.**

Microscope needed. At some points in the key it is essential to count accurately the number of pericentral siphons. Although for some species this can be done by counting in surface view and doubling the number, counting is easier and more accurate if a section across the main axis is taken with a sharp scalpel. This is not difficult with a little practice, and the resulting section will show the number of primary siphons, secondary siphons (if present), and the relative size of the central siphon. These and other features are shown in Fig. 9 below. (See also Feldmann, 1981.)

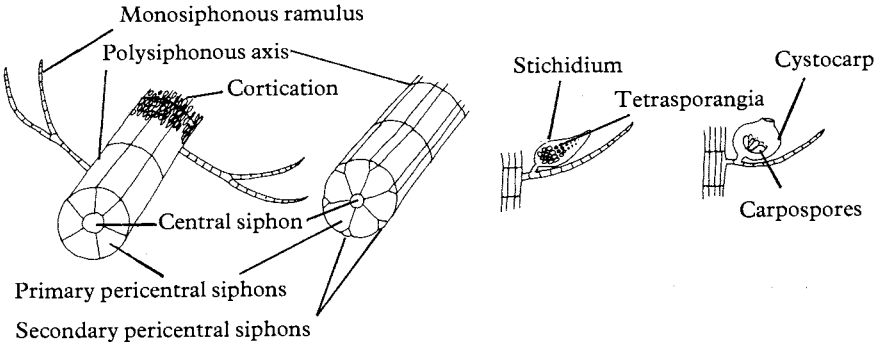


FIG. 9

Basic structures of polysiphonous algae.

1 — Plants with monosiphonous lateral ramuli (see Fig. 9) 2

— Plants without monosiphonous ramuli (except for occasional terminal tufts of hairs) 7

2(1) — Plants with ramuli pinnate and markedly flattened growth form. Bright to dark red. Main axes and side branches conspicuous. To 20 cm. Clothed with ramuli; smaller branches alternate, clothed with simple or forked ramuli. Main axes consisting of a central siphon and 9 pericentrals. Lower littoral and sublittoral, on rock, algae and kelp stipes. Common

Heterosiphonia plumosa (*Fig. 30*)

— Plants with ramuli tufted all around main axes 3

3(2) — Plants to 30 cm. Long main axes with long alternate side branches. Crimson to dark purplish. Axes clothed with short monosiphonous ramuli, branched dichotomously. Occasionally with creeping axes. Lower littoral and sublittoral. Common

Brongniartella byssoides (*Fig. 30*)

— Plants less than 10 cm, tufted. Tetrasporangia in stichidia. *Dasya* spp (difficult—4 species all rare except *D. hutchinsiae*, and stichidia generally needed for identification) 4

4(3) — Ramuli long and tapering to a sharp point. Stichidia with long pointed apices. To 10 cm. Rare. S coast of England

Dasya corymbifera

— Ramuli blunt 5

5(4) — Ramuli very fine (7 μm), 2–5 mm long, sometimes whorled. Stichidia ovate or spindle shaped. Blood red. To 10 cm. Sublittoral. Rare. S coast

Dasya punicea

— Ramuli about 20 μm broad 6

6(5) — Plants crimson or brownish, stichidia mucronate  To 10 cm. Lower littoral pools and sublittoral. Occasional, locally frequent

Dasya hutchinsiae (*Fig. 30*)

— Plants brownish, or purple. Stichidia lanceolate. To 8 cm. Sublittoral, very rare, S coast
Dasya ocellata

7(1) — Three siphons. Much branched irregularly, forming a matted ball 2–3 cm across on other algae. Often free-floating. Shallow sublittoral. S and W coasts to N Scotland 

'Falkenbergia' (tetrasporophyte) phase of **Asparagopsis armata** (*Fig. 28*)

— More than 3 siphons 8

8(7) — Plants growing on *Ascophyllum nodosum* (occasionally on *Fucus* species—brown seaweed, see Hiscock, 1979). Tufted. To 8 cm. Branching dichotomous, apices outspread. Dark reddish brown. 12–24 siphons around large central. Common. Midlittoral 

Polysiphonia lanosa (*Fig. 31*)

— Plants not on *Ascophyllum nodosum* or *Fucus* spp 9

9(8) — 20 or more siphons around a large central. Ecorticate. Ramuli spinelike, plants not flattened. To 9 cm. Rare. Guernsey
Polysiphonia opaca

— Less than 20 siphons, or if with 20 siphons then with fronds flattened at ends 10

10(9) — Plants with markedly flattened growth form and compressed axes 11

— Plants not flattened, or only at ends. Axes cylindrical 13

11(10) — Erect axes simple or branched only once or twice, arising from creeping axes. Ramuli very regularly alternate, short and spinelike. Less than 3 cm long. Lower littoral and sublittoral, often on sand-covered rocks, S and W coasts, N to Pembroke 

Pterosiphonia pennata (*Fig. 29*)

— Plants usually much branched 12

12(11) — Main axes wide, 1–2 mm. Plants simple near base, much branched above. To 10 cm. Axes with short, close-set, alternate, pinnate ramuli, further divided alternately. Lower littoral and sublittoral fringe. Local, S and W coasts of Britain and Ireland. (See also *Pterosiphonia thuyoides*, 30 below) 

Pterosiphonia complanata (*Fig. 29*)

— Main axes narrow, less than 0.25 mm. Plants to 5 cm. Main axes clothed with alternate ramuli, becoming very small at branch ends. Lower branches often longer than upper, spreading. Lower littoral and sublittoral, particularly sublittoral fringe. Common but inconspicuous 

Pterosiphonia parasitica (*Fig. 29*)

13(10) — Four primary pericentral siphons  (may also have 4 secondary siphons in older parts) 14

— More than 4 primary pericentral siphons 23

14(13) — Cortication covering most of main axes, or only near base 15

— Cortication absent 19

POLY.

15(14) — Plants corticate only at extreme base. Plants to 23 cm. Red. Tufted. Main branches with numerous ramuli, often with hairlike fibrillae at tips. 4 siphons around minute central. Cystocarps ovate, stalked with large ostiole. (Similar to *P. urceolata* but darker in colour and gelatinous)
Polysiphonia fibrata

— Plants corticate throughout main axes; plants not as above 16

16(15) — Plants large, to 30 cm. Younger parts red, gelatinous; older parts brownish, very dark, cartilaginous. Siphons; 4 primary alternating with 4 secondary; sometimes 8 tertiary siphons in older parts. Branches naked during the winter, clothed in spring with dense ramuli, attenuate at base and apex. Lower littoral and sublittoral, often on stones in mud. Common

Polysiphonia elongata (*Fig. 31*)

Note. *Polysiphonia elongella* is very similar, but with cortication much less developed. Siphons visible through cortication except near extreme base. Ramuli not attenuate at base. Rare, low water and sublittoral

— Plants less than 15 cm. Not as *P. elongata* (see Fig. 31). If cartilaginous then not red 17

17(16) — Plants to 5 cm. Dark red. Clothed with short spinelike ramuli. Cystocarps ovate, sessile on the smaller branches. Siphons 4 primary alternating with 4 secondary. Rare. Argyll
Polysiphonia spinulosa

— Plants to 15 cm. Brownish purple to straw coloured 18

18(17) — Cystocarps with short stalk. Usually 4 primary siphons alternating with 4 secondary; sometimes only 4 primary. Main axis conspicuous at base, soon becoming alternately branched. Branches densely clothed with alternate ramuli. Lower littoral and sublittoral, on rock and other algae. Occasional. (Possibly the same species as *P. fibrillosa* below)
Polysiphonia violacea (*Fig. 32*)

— Cystocarps sessile on the smaller branches. 4 primary siphons alternating with 4 secondary. Otherwise as *P. violacea* above (possibly the same species)
Polysiphonia fibrillosa

19(14) — Plants usually less than 3 cm high 20

— Plants more than 3 cm high 21

20(19) — Plants dark red or reddish brown. Main branches subdichotomous, ramuli alternate or unilateral, often directed backwards. Littoral on rock, tolerant of some sand cover. Common

Polysiphonia macrocarpa (*Fig. 32*)

Note. *P. spiralis* also keys out here, but is a doubtful species. The main characteristic is spiral siphons, but a number of species show this character to some degree. Plants gelatinous, large central siphon

— Plants dark purple. Erect axes unbranched or with a few ramuli. Rare. Cork Harbour, Ireland
Lophosiphonia subadunca

21(19) — Plants red. To 15(25) cm. Texture coarse. Branching subdichotomous, ramuli alternate. Minute central siphon. Cystocarps elongate, with short stalk. On rock, limpets and other algae, particularly kelp stipes. Mid littoral to shallow sublittoral. Common

Polysiphonia urceolata (*Fig. 32*)

Note. Very similar is *P. fibrata,* but gelatinous, usually darker red, often with a band of corticating cells at extreme base. Ramuli often with tufts of hairs at tips. Cystocarps ovate, stalked, with large open ostiole. Extreme lower littoral, frequent

— Plants greyish or reddish brown. To 10 cm. Rare 22

22(21) — Plants greyish brown. Branching subdichotomous with alternate or unilateral ramuli. Cystocarps ovate, sessile on the ramuli. On muddy rocks and other algae, lower littoral. Rare. S coast of England

Polysiphonia insidiosa

— Plants reddish brown. Branching alternate, branches clothed with ramuli. Cystocarps shortly stalked, almost sessile, ovate with short ostiole. On rock, lower littoral. Rare. S coast of England

Polysiphonia rhunensis

23(13) — Plants with 5–6 primary pericentral siphons  24

— Plants with more than 6 primary pericentrals 27

24(23) — Plants ecorticate 25

— Plants corticate (look at lower parts) 26

25(24) — Erect axes unbranched or with a few ramuli, arising from a creeping base. 4–6 pericentral siphons. Plants dark purple. Very rare. Cork Harbour, Ireland

Lophosiphonia subadunca

— Erect axes much branched, from a disc base. 5 pericentrals around a smaller central. Very rare. Kirkudbright, Scotland

Polysiphonia richardsonii

26(24) — Plants corticate throughout main axes, obscuring siphons. Usually with distinct main axis, clothed with alternate or spiral tufts of dense, flaccid ramuli. Siphons 6–8 primary, alternating with the same number of secondary. Cystocarps ovate, shortly stalked. Plants to 25 cm long. Lower littoral and shallow sublittoral, usually in turbulent or exposed areas. Common 

Polysiphonia brodiaei (*Fig. 31*)

— Plants corticate only in lower parts. Branching subdichotomous, branches widely divergent. Siphons 6 pericentral. Cystocarps broadly ovate at the base, shortly stalked on the smaller ramuli. Plants to 25 cm long. On rock, other algae and *Zostera*, muddy sites and estuaries. Rare. S England

Polysiphonia denudata

27(23) — Plants corticate (look at lower parts) 28

— Plants ecorticate 31

28(27) — Plants corticate near base only. 12–20 siphons around a large central (1/3 diameter of filament). Variable in size, to 15(30) cm. In tufts, branching irregular below, much divided alternately above and flattened at branch ends. Dark brownish purple to black, often red in youngest parts. May be reduced to short portions of old axes after storms; then can be confused with *Lophosiphonia reptabunda* (see 34 overleaf). On rock, middle and lower shores, tolerant of sand cover. Common. (*Pterosiphonia thuyoides* (see 30 overleaf) can be very similar, but usually corticate throughout main axes) 

Polysiphonia nigrescens (*Fig. 31*)

— Plants corticate throughout main axes. 8–12 primary pericentral siphons. Plants not as above  29

29(28) — Main axes consisting of 6–8 primary siphons alternating with 6–8 secondary. Cortication obscuring siphons. See 26 above 

Polysiphonia brodiaei (*Fig. 31*)

— Main axes consisting of 8–12 primary siphons; secondary siphons absent but may be more than 1 layer of corticating cells 30

POLY.

30(29) — Ramuli set at a wide angle, giving plant a characteristically angular appearance. Frond very springy; dark brownish purple. Plants much branched, roughly subdichotomous in the main branches, clothed with short, spinelike ramuli, themselves branched alternately. Branched in all directions, pinnate only in smallest ramuli. To 15 cm long. On rock and other algae, in warm, shallow littoral pools. Locally frequent; S England and Ireland. Rare, N England and Scotland
Polysiphonia fruticulosa (*Fig. 31*)

— Ramuli not set at a wide angle. Frond not springy; dark brownish red to black. Main branching irregular, clothed with regularly alternate short, pinnate ramuli. Erect axes from a creeping base. To 15 cm long. In shallow littoral pools on rock and other algae. (Can be similar to *Polysiphonia nigrescens*, see 28 p. 61)
Pterosiphonia thuyoides (*Fig. 29*)

31(27) — Axes with 8–10 primary pericentral siphons  32

— Axes with more than 10 primary pericentral siphons 34

32(31) — Plants without short lateral ramuli. Brick red. Well-marked central axis and numerous widely spread laterals. Siphons; 8–9 around a small central. To 14 cm. Sublittoral. Rare. S England and Ireland
Polysiphonia furcellata

— Plants with short lateral ramuli. Dark red to black 33

33(32) — Ramuli simple, short, spinelike, attenuate at base and apex. Plants to 30 cm. Dark red to black. Main axis often subdichotomous, smaller branches alternate, with few to numerous ramuli. Siphons 8–14 round a large central. Lower shore or more usually sublittoral, on rock, stones and shells, locally frequent 
Polysiphonia nigra (*Fig. 31*)

— Ramuli in tufts, divided alternately or subdichotomously. Plants to 10 cm. Dark red to black. Much branched. 8–10 siphons. Lower littoral, on rock and other algae. Rare. S coast of England, W Ireland
Polysiphonia foetidissima (*Fig. 32*)

34(31) — Plants less than 3 cm. In tufts. Little branched, sometimes with a few ramuli. 12–18 siphons round a large central. On rock and smaller algae. Very rare. S coast of England, S and W Ireland. (Beware battered *Polysiphonia nigrescens*, see 28 p. 61)
Lophosiphonia reptabunda

— Plants usually more than 3 cm. Usually much branched 35

35(34) — More than 15 (up to 20) siphons. See 28 p. 61 
Polysiphonia nigrescens (*Fig. 31*)

— Siphons 14 or less 36

36(35) — Ramuli tapered at base and apex. Plants not flattened at tips. Very dark red or black. See 33 above 
Polysiphonia nigra (*Fig. 31*)

— Ramuli not tapered at base 37

37(36) — Plants with small central siphon. Tufted from the base, deep red. To 20 cm. Branches set with short, spinelike ramuli. Siphons 12–13 around a small central. Rare. Sublittoral
Polysiphonia subulifera

— Central siphon 1/3 to 1/2 diameter of the filament 38

38(37) — Filaments with 12 siphons. Plants dark red. Branches alternate, sparsely clothed with irregularly pinnate ramuli, tapering sharply at apices. Lower littoral on rock. Rare
Polysiphonia simulans (*Fig. 32*)

— Filaments with 14 siphons. Plants dark red in younger parts, black below. Flattened growth form at front tips. See 28 p. 61

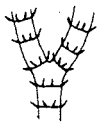
Polysiphonia nigrescens (*Fig. 31*)

KEY TO **Ceramium** SPECIES

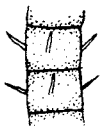
Note. It may be necessary to use a microscope to see the spines and their structure.

1 — Axis with small spines, unicellular  or multicellular  . May be worn off in older parts—look near apices 2

— Spines absent 5

2(1) — Spines whorled at each node, or irregular. Unicellular or multicellular  3

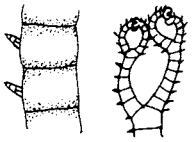
— Spines borne singly on the outside of each node. Multicellular  4

3(2) — Spines unicellular, small, needle shaped, whorled or irregular on main axis. Cortication complete. Tetrasporangia on outer edge of filament, 1–2 in each articulation. Much branched dichotomously, often with lateral branches. Apices strongly hooked inwards. Plants purplish red. Densely tufted, texture harsh. To 15 cm long. Littoral on rock and in rock pools on other algae 

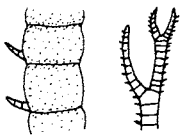
Ceramium echionotum (*Fig. 32*)

— Spines multicellular, whorled. Cortication incomplete. Tetrasporangia in whorls in the corticating cells, alternating with the spines. Repeatedly dichotomous. Otherwise appearance as *C. echionotum* above. Littoral and shallow sublittoral 

Ceramium ciliatum (*Fig. 32*)

4(2) — Cortication incomplete. Apices strongly hooked inwards. Spines not clearly delimited from the axis at base. Plants dark purple. To 15 cm. Densely matted. Repeatedly dichotomous. Middle and lower littoral, on rock, mussels and other algae. Common, particularly on exposed shored 

Ceramium shuttleworthianum (*Fig. 32*)

— Cortication complete. Apices acutely pointed, spreading or slightly incurved, not strongly hooked inwards. Spines often clearly delimited from main axis at base. Spines sparse, inconspicuous basal cell deeply pigmented. Plants dull red. To 8 cm. Somewhat cartilaginous, tufted but not matted together. Irregularly dichotomous. Littoral on other algae, frequent 

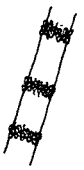
Ceramium flabelligerum (*Fig. 32*)

CER.

5(1) — Unfortunately, the taxonomy of the non-spiny *Ceramium* species is in chaos at present, and we still await clarification from the experts. Parke and Dixon (1977) list 11 species for the British Isles, with a further 9 of doubtful occurrence. The commonest of these non-spiny *Ceramium* spp fall into two main groups; *C. rubrum* agg. and *C. diaphanum* agg., with a range of forms in between classified mainly on the degree of cortication at the nodes, and the length of axial cells, both features being notoriously variable. A key and description of these two groups is given below.

— Plants completely or almost completely corticate (axes covered with tiny cells).  Plants deep clear red, or from reddish brown to greenish yellow when bleached. To 30 cm, gradually attenuate upwards, irregularly dichotomous, often with lateral branches which may be simple, forked or repeatedly dichotomous. Apices straight or forcipate. Plants very variable in form and size. On rock or other algae, from upper littoral pools to sublittoral, sometimes loose-lying. Common and ubiquitous

Ceramium rubrum agg. (*Fig. 32 & Plate 4a*)

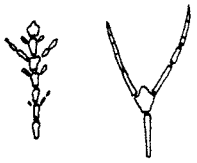
— Plants corticate only at the nodes, with long uncorticated clear sections between, giving a noticeably striped or beaded appearance. Dull reddish or purplish. Often very fine, apices often strongly hooked. Typically on stones in sand and mud on the lower shore and sublittoral. Sheltered situations 

Ceramium strictum agg.

GROUP E

Plants calcareous, hard and limy; plants with erect jointed fronds, or free living as maerl or rhodolith nodules, or encrusting rock and other algae.

The taxonomy of British calcareous (coralline) algae is complex and still being worked on by specialists. Their identification, particularly of crustose species, is generally beyond the scope of this key; however, a key to non-crustose species and those forming free-living maerl nodules or rhodoliths, is attempted below. Coralline algae are generally fertile in winter, when reproductive structures can be seen as small pink or white dots. Crustose corallines not treated in this key include species of ***Dermatolithon, Fosliella, Leptophytum, Lithophyllum, Lithothamnium, Melobesia, Mesophyllum, Phymatolithon, Pneophyllum*** *and* ***Titanoderma.*** *A vegetative and other keys to epilithic crustose species can be found in Adey and Adey (1973), but are difficult to use.*

1 — Plants with erect jointed fronds  2

— Plants without jointed fronds, lobed, branched or knobbly, forming free-living nodules (maerl) or completely covering small stones (rhodoliths) or leafy lobes on other algae 4

Note. Small and old or abraded plants can be difficult to identify, as can plants growing out of their normal depth. Colours refer to living plants or plants dried quickly in the shade

2(1) — Branching dichotomous throughout, branches very fine. In dense tufts 2–5 cm high, usually on *Cladostephus spongiosus* (a brown seaweed—see Hiscock, 1979). Lower littoral and sublittoral, locally common 

usually **Jania rubens** (*Fig. 35*), rarely **J. corniculata**

— Branching opposite over at least part of plant 3

3(2) — Plants with disc holdfast. Branches never dichotomous. To 12 cm. Pink. Mid littoral to sublittoral. Common 

usually **Corallina officinalis** (*Fig. 35 & Plate 3b*)
(Also **C. elongata**—with horned reproductive organs. Rare. S coast; and
C. granifera—with very narrow branches. Rare. N Ireland)

— Plants with branched holdfast. Main (primary) branches dichotomous. To 10 cm. On rock and other algae. Lower littoral and sublittoral. Southern distribution

Haliptilon squamatum

4(1) — Plants forming small, thin leaf-like flattened lobes, usually on *Corallina* sp. Individual lobes to 1 cm across, but collectively sometimes forming large masses. Reproductive structures circular and raised, to 1.5 mm across, leaving small rings after spore release. Lower littoral pools and sublittoral fringe. S and W coasts, locally common 

Mesophyllum lichenoides (*Fig. 35 & Plate 4b*)

— Plants not thin and leaflike, reproductive structures less than 1 mm across. Branched and coral-like, or encrusting and knobbly 5

5(4) — Plants usually distinctly branched, forming coral-like nodules  or compressed branched discs 6

— Crusts with mounds, knobbles or simple undivided branches  9

GROUP E

6(5) — Branches less than 1.5 mm wide 7

— Branches more than 1.5 mm wide 8

7(6) — Dried plants pink, surface texture smooth and slightly glossy. Absent from the far N of Scotland **Lithothamnion corallioides** (*Fig. 35*)

— Dried plants dull lilac (beware encrusting dark red algae), surface texture dull and chalky. Common constituent of maerl beds in the lower littoral and shallow sublittoral. Often found as a flattened form (branched in one plane) in areas of strong tidal streams in the sublittoral **Phymatolithon calcareum** (*Fig. 35*)

8(6) — Dried plants dull lilac (beware encrusting red algae), surface texture chalky, branch tips often truncated and broader than the branches below. Common constituent of maerl beds in the lower littoral and shallow sublittoral. Often found as a flattened form (branched in one plane) in areas of strong tidal streams in the sublittoral **Phymatolithon calcareum** (*Fig. 35*)

— Dried plant purple-pink or lilac-pink, surface texture smooth (except for reproductive structures showing as small white speckles), not chalky. A wide range of form from much-branched maerl nodules to a lumpy coating on stones. Common constituent of maerl beds in the N; northern distribution, S to Lundy **Lithothamnion glaciale** (*Fig. 35*)

9(5) — Crusts very pale, greyish pink, thick and smooth but with chalky surface texture when dry. Often with high convoluted ridges where neighbouring crusts meet, and occasional branches to 3 mm high. Encrusting stones and shells (and bedrock), often with complete cover over old worm tubes etc. Lower littoral (often sandy) pools, and sublittoral fringe **Lithophyllum incrustans**

— Crusts pinkish or reddish violet, surface not chalky 10

10(9) — Branches small, several mm long, narrow, or crusts with small mounds. Hard and glossy, reddish. Only occasionally occurring as rhodoliths. Deep water, especially below 15 m **Lithothamnium sonderi**

— Branches thick, more than 3–4 mm across 11

11(10) — Colour bluish pink. Smooth, 'flowing' appearance. Glossy. Usually 1 to several mm thick, but known up to 20 cm. Often forming a smooth crust, but sometimes very irregular and forming knobbly projections. Only occasionally occurring as rhodoliths **Phymatolithon polymorphum** (*Fig. 35*)

— Colour reddish, usually with numerous small white speckles. Becoming extensive and thick. Occurring on all hard substrates and often continuing growth when detached, forming beds of rhodoliths. Usually with abundant irregular or regular branches. Northern distribution, S to Lundy **Lithothamnium glaciale** (*Fig. 35*)

GROUP F

Plants encrusting on rock, shells or other plants and animals. Non-calcareous (except perhaps slightly on underside of *Peyssonelia* spp).

Largely beyond the scope of this key, as microscopic features needed. A lateral key to non-calcareous crusts is in preparation (C. A. Maggs). However, a few species can be easily identified without a microscope, or are common on shore and sublittorally, sometimes forming extensive patches. A brief key to plants larger than 1 cm is given below, but should be regarded as provisional only.

(Plants usually less than 1 cm include species of ***Cruoriopsis, Erythrocladia, Schmitziella endophloea*** *(in* ***Cladophora pellucida****),* ***Neevea*** *(on hydroids),* ***Erythropeltis*** *(on* ***Flustra****),* ***Colacodictyon*** *(on* ***Desmarestia dresnayi****),* ***'Hymenoclonium'*** *(phase of* ***Bonnemaisonia asparagoides****),* ***Audouinella*** *(32 spp on various substrates),* ***Porphyridium*** *(unicells in mucilage),* ***Rhodophysema georgii*** *(cushions <1 mm on* ***Zostera****))*

1 — Plants with small (to 2 mm) papillae; crusts with undulating outline, often completely covering small stones. Habitat apparently very specialised—small mobile stones in tidal streams, sublittoral. So far only known from a few sites in S and W Britain and Ireland (see Guiry and Maggs, 1982)
Dermocorynus montagnei (*Fig. 35*)

— Crusts without papillae 2

2(1) — Crusts thick (more than 200 μm), easily removed with thumbnail, or hard and lobed 3

— Crusts very thin (usually <80 μm) 12

3(2) — Plant soft, easily squashed under coverslip 4

— Plant hard, coverslip breaks first 5

4(3) — Crusts forming large patches on sublittoral rock, also on shells. Wave-exposed sites. Widespread
Cruoria pellita

— Small patches on maerl. Sublittoral. Rare. Falmouth and Galway
Cruoria cruoriaeformis

5(3) — Lower surface lime encrusted. Plants attached by rhizoids 6

— Lower surface not limy. Plants attached by whole undersurface 9

6(5) — Crusts wrinkled when dry. To 3 cm. Dark red or purplish. Edges sometimes lobed, cells arranged in fans (squash on slide). On encrusting calcareous algae, shells and stones
Peyssonnelia dubyi

— Crust not wrinkled when dry (may have radial or concentric markings) 7

7(6) — Margins very closely attached to substrate; crust without radial or concentric markings when blotted dry. Red-purple. See Maggs and Irvine (1983)
Peyssonelia immersa

— Margins free; crust with radial or concentric markings when blotted dry 8

8(7) — Crusts purplish or brownish. To 9 cm or more, and to 500 μm thick. Dry crusts usually showing concentric rings. Often littoral, loosely encrusting corallines and occasionally other algae. SW to Isle of Man
Peyssonnelia atropurpurea

— Crusts red. To 3 cm and to 250 μm thick. Dry crusts showing radial striations. Encrusting coralline algae and shells
Peyssonnelia harveyana

GROUP F

9(5) — Crusts small. To 3 cm and to 150–300 μm thick. Dull violet or purple. Tetrasporangial sori raised, hemispherical or flat-topped. Tetrasporophyte of *Ahnfeltia plicata*
Porphyrodiscus simulans

— Crusts extensive. Red to dark purplish brown. Tetrasporangial sori sunk in crust 10

10(9) — Crusts dark, can be squashed. Littoral. Tetrasporophyte of *Mastocarpus stellatus* (= *Gigartina stellata*)
Petrocelis cruenta

Note. *P. hennedyi* is a rare, closely similar species distinguishable only microscopically

— Crusts red, do not squash. Littoral and sublittoral 11

11(10) — Crust dries smooth and glossy. Mainly littoral. Tetrasporophyte of *Schizymenia dubyi*
Haematocelis rubens

— Crust dries distinctly fissured. Lower littoral and sublittoral. White spots visible on surface view with lens. Tetrasporophyte of *Sphaerococcus coronopifolius* (see Maggs and Guiry, 1982c)
Haematocelis fissurata

12(2) — Plants extensive. Reddish brown. Littoral, ubiquitous, on hard especially siliceous rock. Reproductive bodies in pits just visible with lens when surface blotted dry
Hildenbrandia rubra and **Hildenbrandia crouanii**

— Plants small, less than 2 cm. Includes **Erythrodermis allenii** (see Dixon and Irvine, 1977); **Cruoria rosea** (tetrasporophyte of **Halarachnion ligulatum,** see Dixon and Irvine, 1977); **Rhododiscus pulcherrimus** (tetrasporophyte of **Atractophora hypnoides,** see Maggs, Guiry and Irvine, 1983); and **Rhodophysema elegans**

GROUP G

Small, usually pale parasites on various algae, usually classified according to the host species; key out the host plant first in sections A to E.

Parasites growing on:

Phyllophora truncata—thallus pinkish. To 5 mm diameter. A cluster of short, terete, irregularly divided, branches of up to 1 mm diameter. Beware reproductive outgrowths (see Dixon and Irvine, 1977). Sublittoral to 10 m. Clare, Shetland
Ceratocolax hartzii (*Fig. 35*)

Jania and *Haliptilon* spp—only reproductive structures visible, protruding from the host surface, rest of parasite inside host. Just visible to the naked eye
Choreonema thuretii (*Fig. 35*)

Callophyllis laciniata—parasite to 4 mm high. Lobed, leafy or irregular, on frond surface of host. Common
Callocolax neglectus (*Fig. 35*)

Polysiphonia lanosa—cushions to 2 mm. Hemispherical or lobed
Choreocolax polysiphoniae (*Fig. 35*)

Rhodomela confervoides—cushions to 3 mm. More or less hemispherical. Often quite dark
Harveyella mirabilis

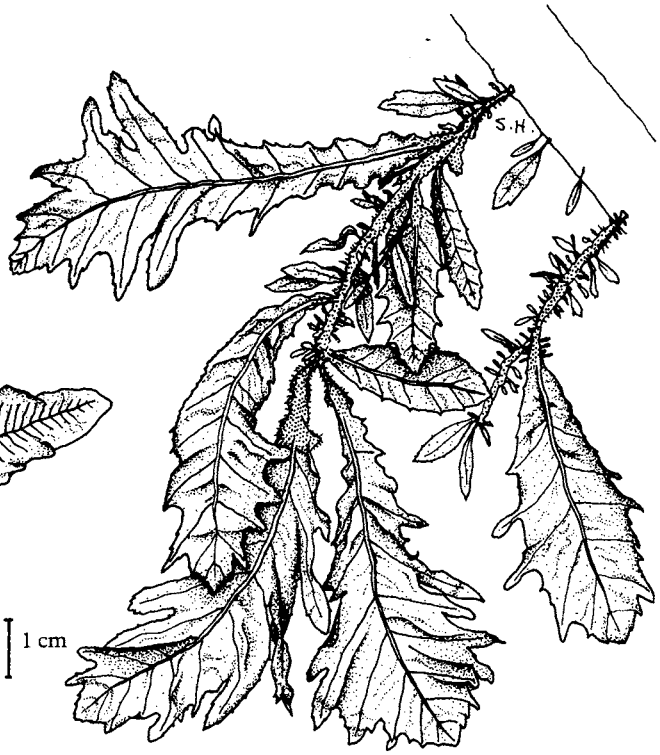
Gracilaria verrucosa—cushions to 3 mm. More or less hemispherical. The reproductive organs of *Gracilaria* are dark; the parasite is white or pale brownish
Holmsella pachyderma (*Fig. 35*)

Palmaria palmata—tiny patches or cushions just visible to the naked eye. Hemispherical or slightly elongate. To 0.5 mm. Colourless
Halosacciocolax kjellmanii

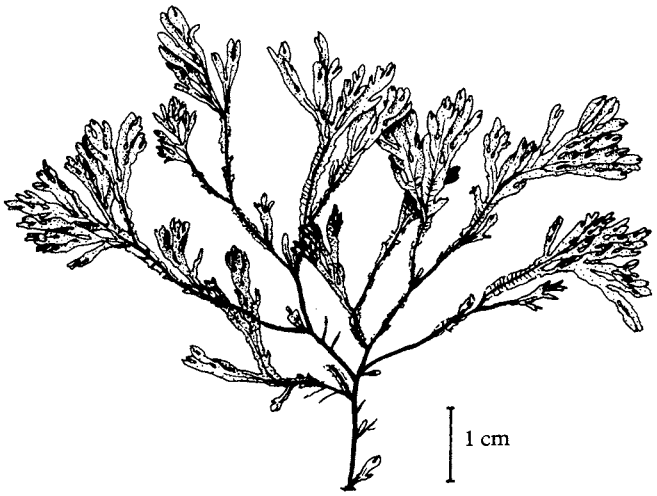
Rhodymenia pseudopalmata—in tufts to 7 mm. Much branched, terete or compressed. Southwest Britain. (See Hiscock and Maggs, 1984)
Rhodymeniocolax sp (*Fig. 35*)

Cryptopleura ramosa—to 4 mm. Lobed or leaflike, in small clusters
Gonimophyllum buffhami (*Fig. 35*)

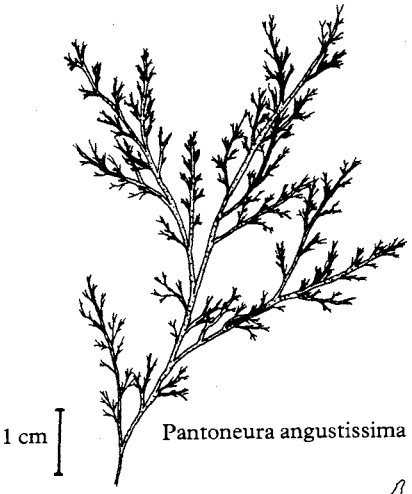
Delesseria sanguinea SEA BEECH
a. Habit; b. Winter branch
with cystocarps



Phycodrys rubens
SEA OAK

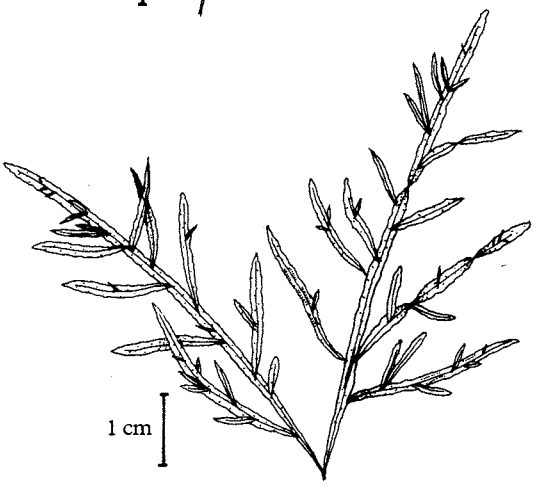


Membranoptera alata



Pantoneura angustissima

Apoglossum ruscifolium



Hypoglossum woodwardii

FIG. 10

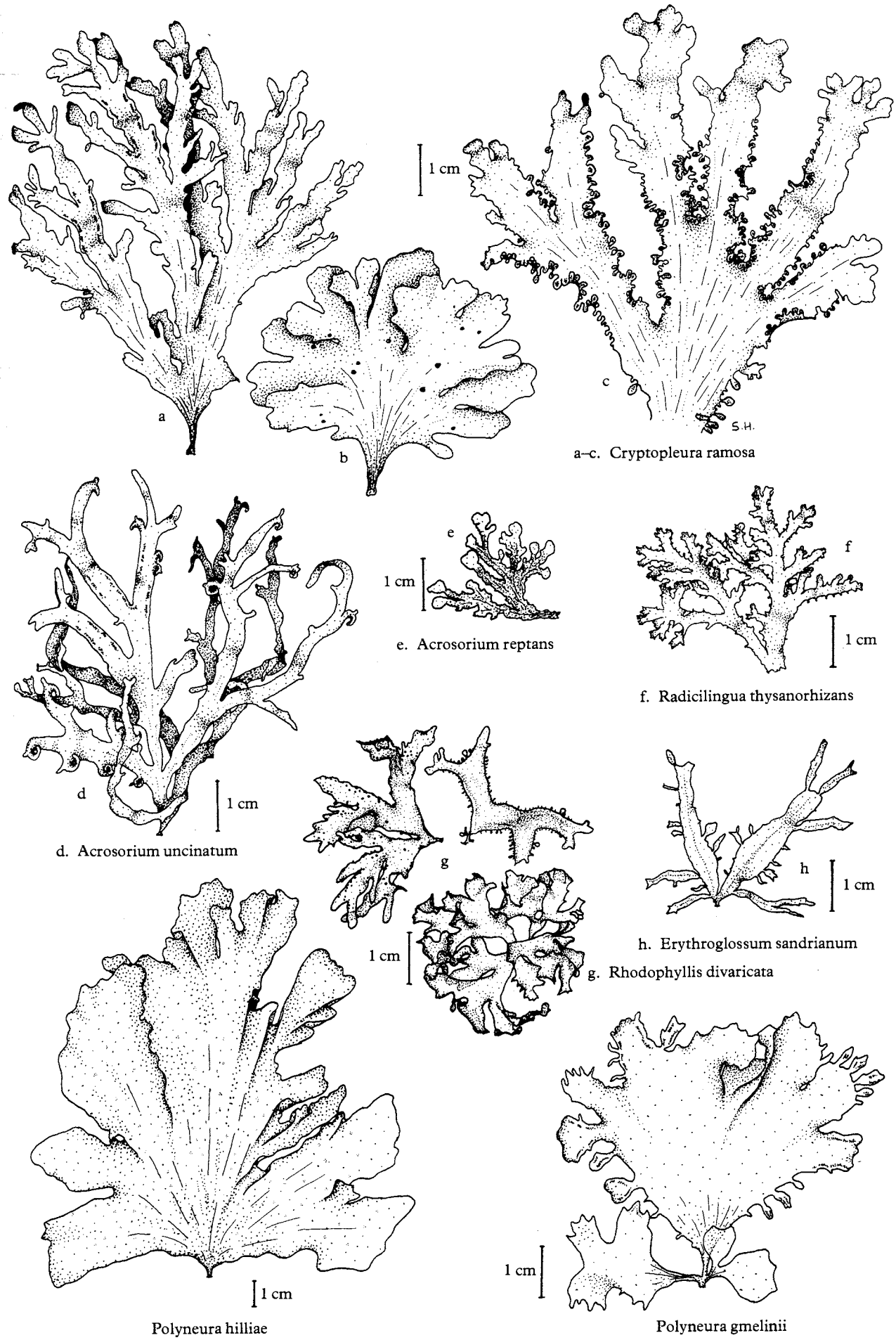
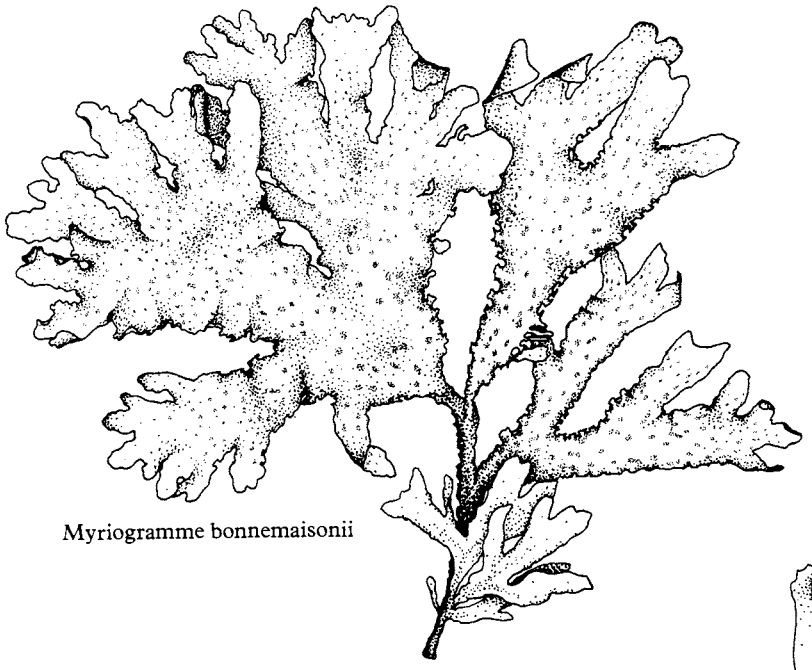
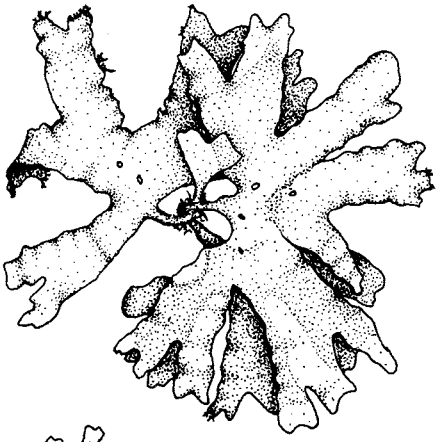

a
b
1 cm
c
S.H.
a–c. Cryptopleura ramosa
d
1 cm
d. Acrosorium uncinatum
e
1 cm
e. Acrosorium reptans
f
1 cm
f. Radicilingua thysanorhizans
g
1 cm
g. Rhodophyllis divaricata
h
1 cm
h. Erythroglossum sandrianum
1 cm
Polyneura hilliae
1 cm
Polyneura gmelinii

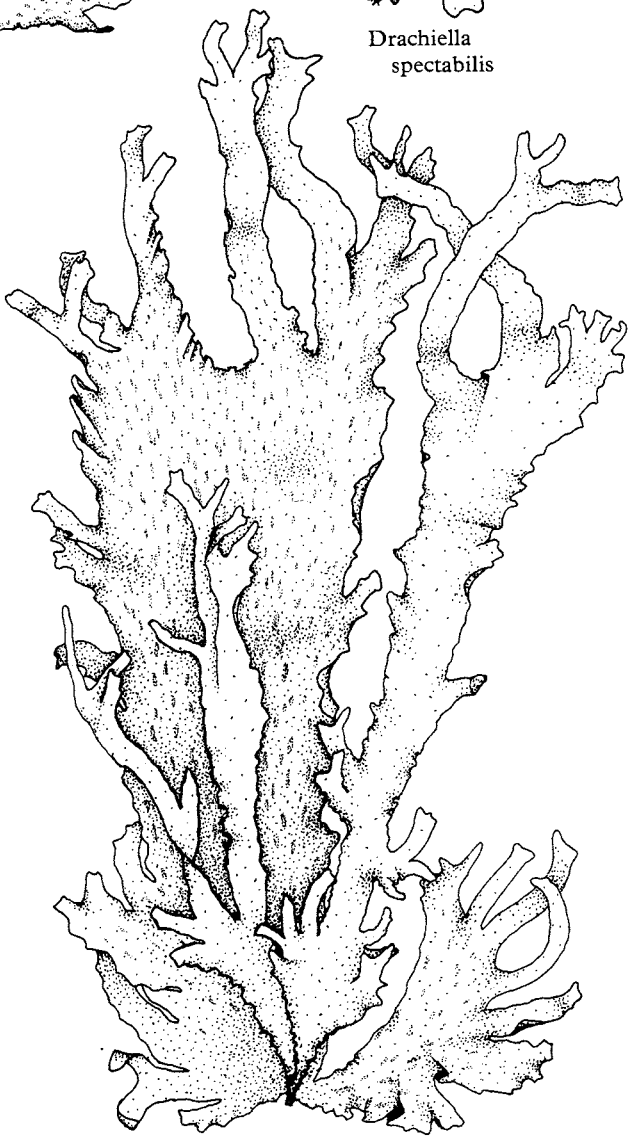
FIG. 11



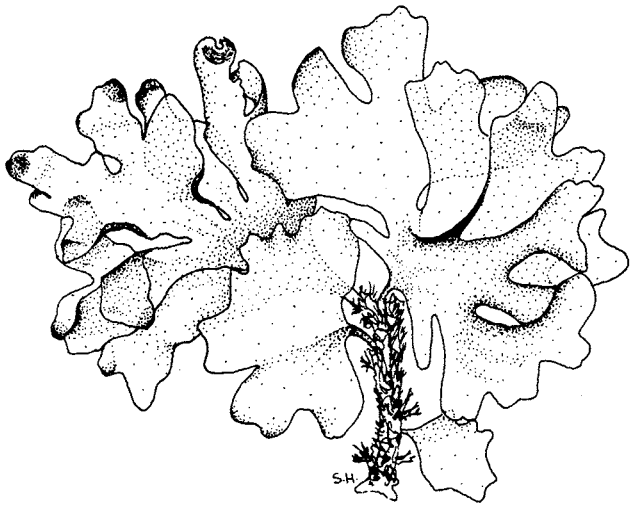
Myriogramme bonnemaisonii



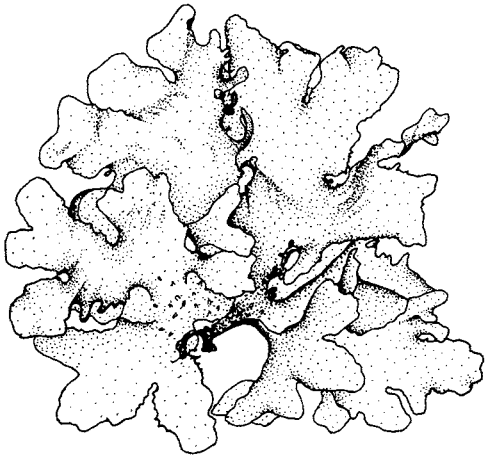
Drachiella spectabilis



Nitophyllum punctatum



Myriogramme heterocarpum



Rhodophyllis sp.

Myriogramme minuta

FIG. 12

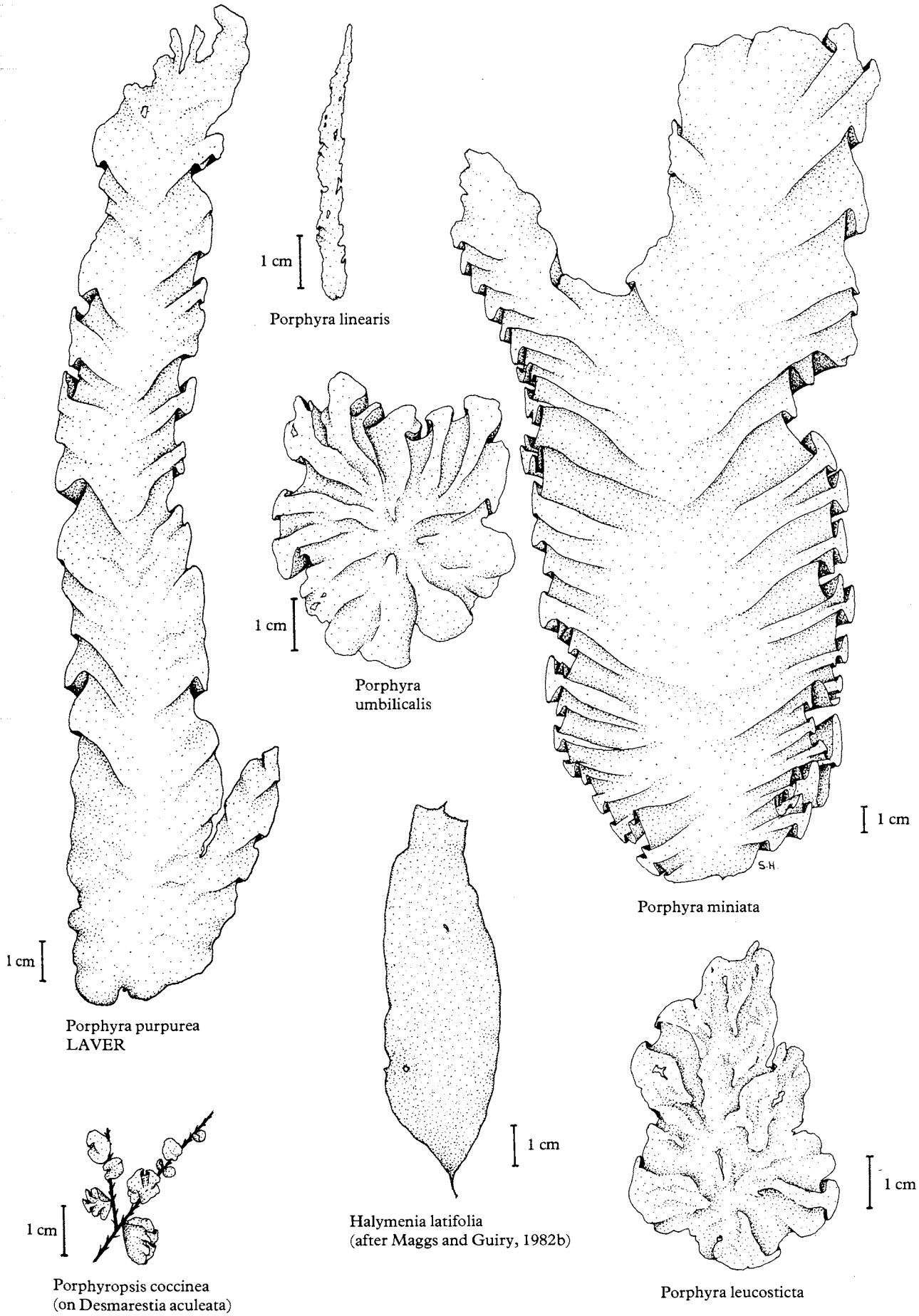

1 cm
Porphyra linearis
1 cm
Porphyra
umbilicalis
1 cm
S.H.
Porphyra miniata
1 cm
Porphyra purpurea
LAVER
1 cm
Halymenia latifolia
(after Maggs and Guiry, 1982b)
1 cm
Porphyra leucosticta
1 cm
Porphyropsis coccinea
(on Desmarestia aculeata)

FIG. 13

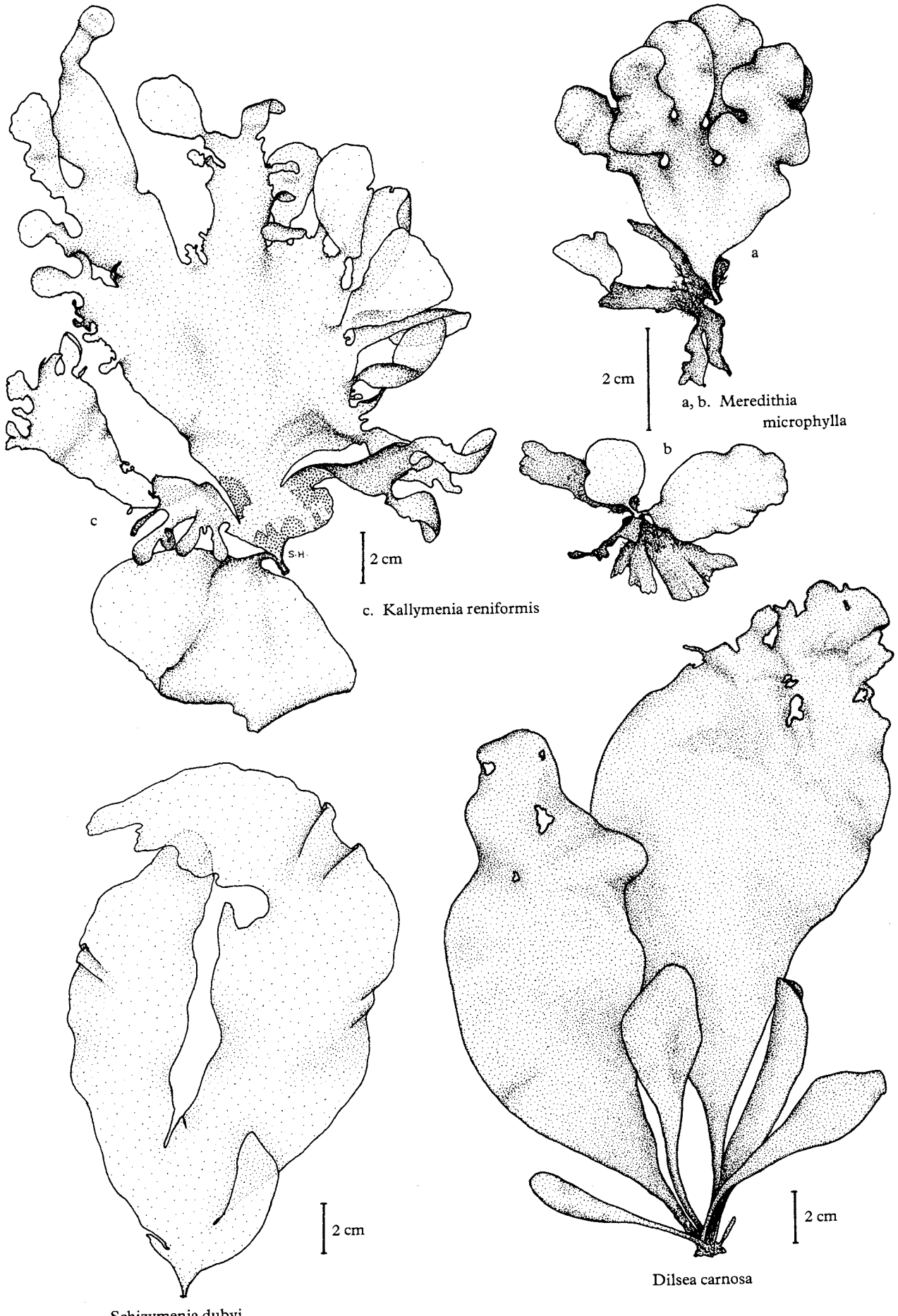
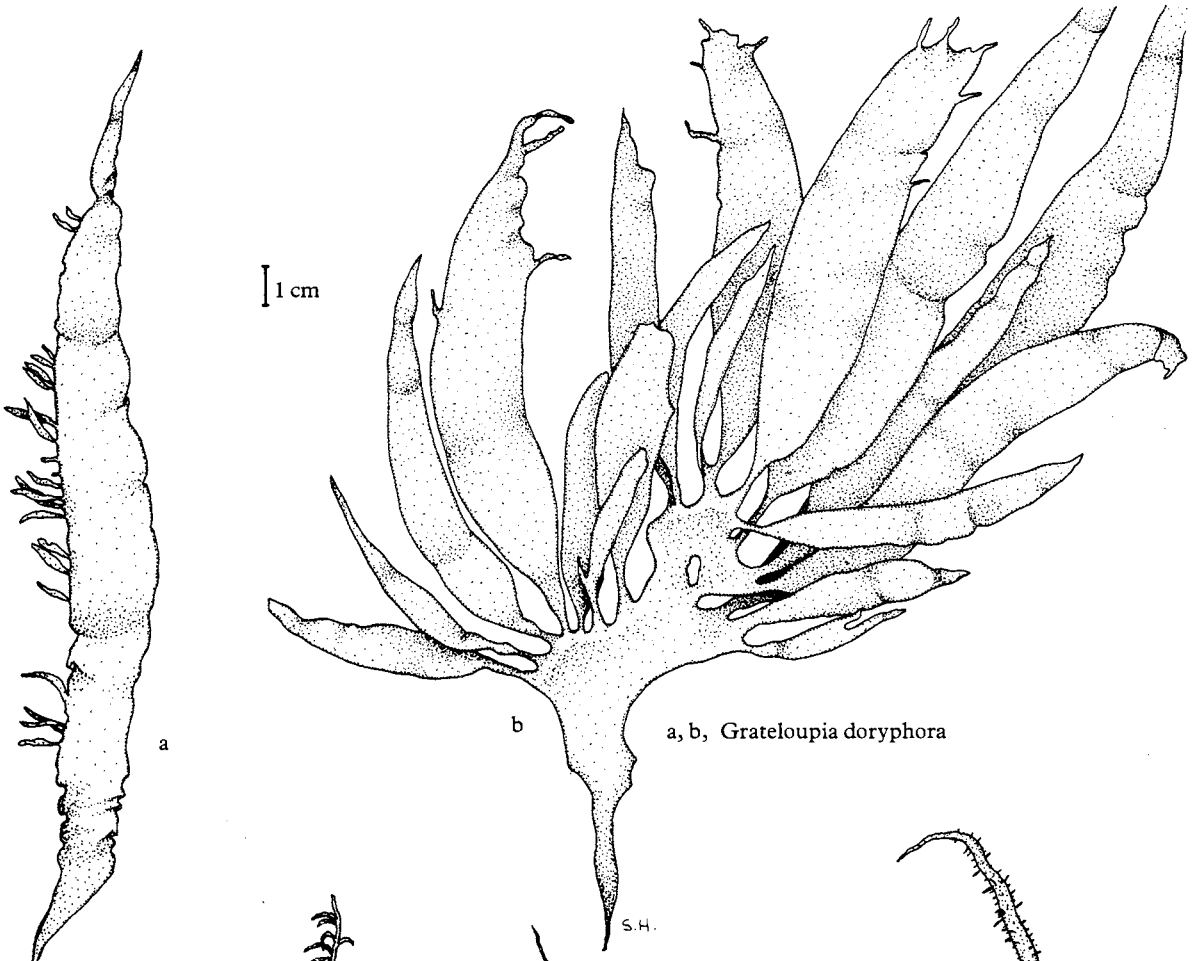
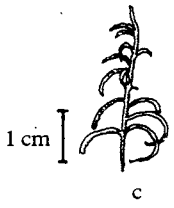

a
2 cm
a, b. Meredithia microphylla
b
c
S.H.
2 cm
c. Kallymenia reniformis
2 cm
Schizymenia dubyi
2 cm
Dilsea carnosa

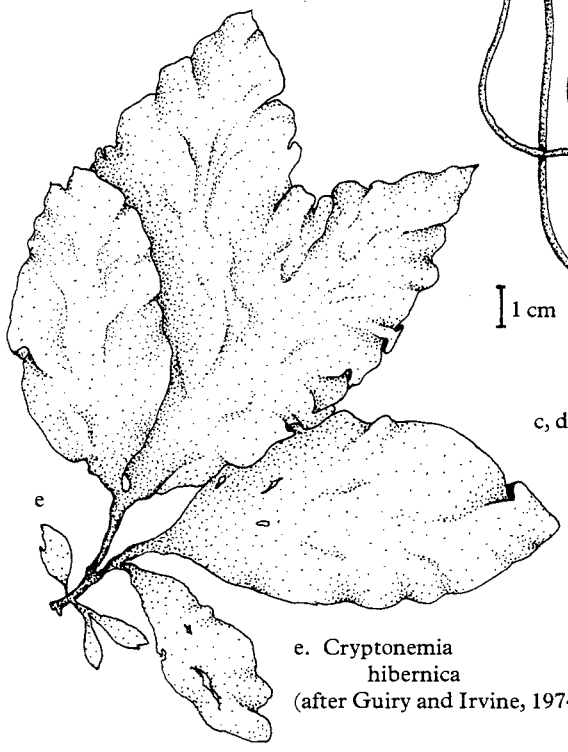
FIG. 14



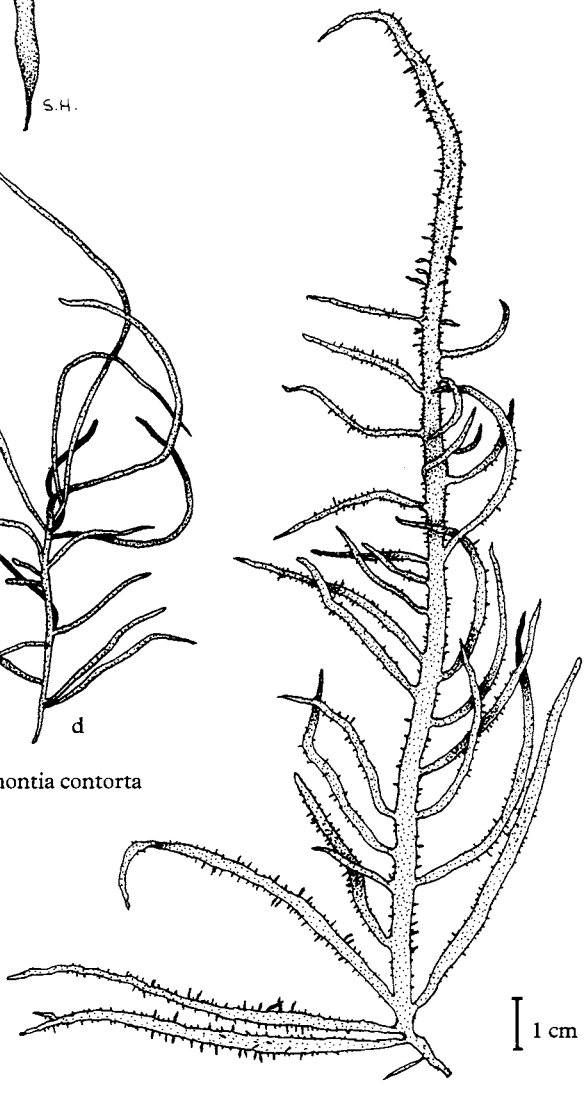
a, b, Grateloupia doryphora



c, d. Dumontia contorta

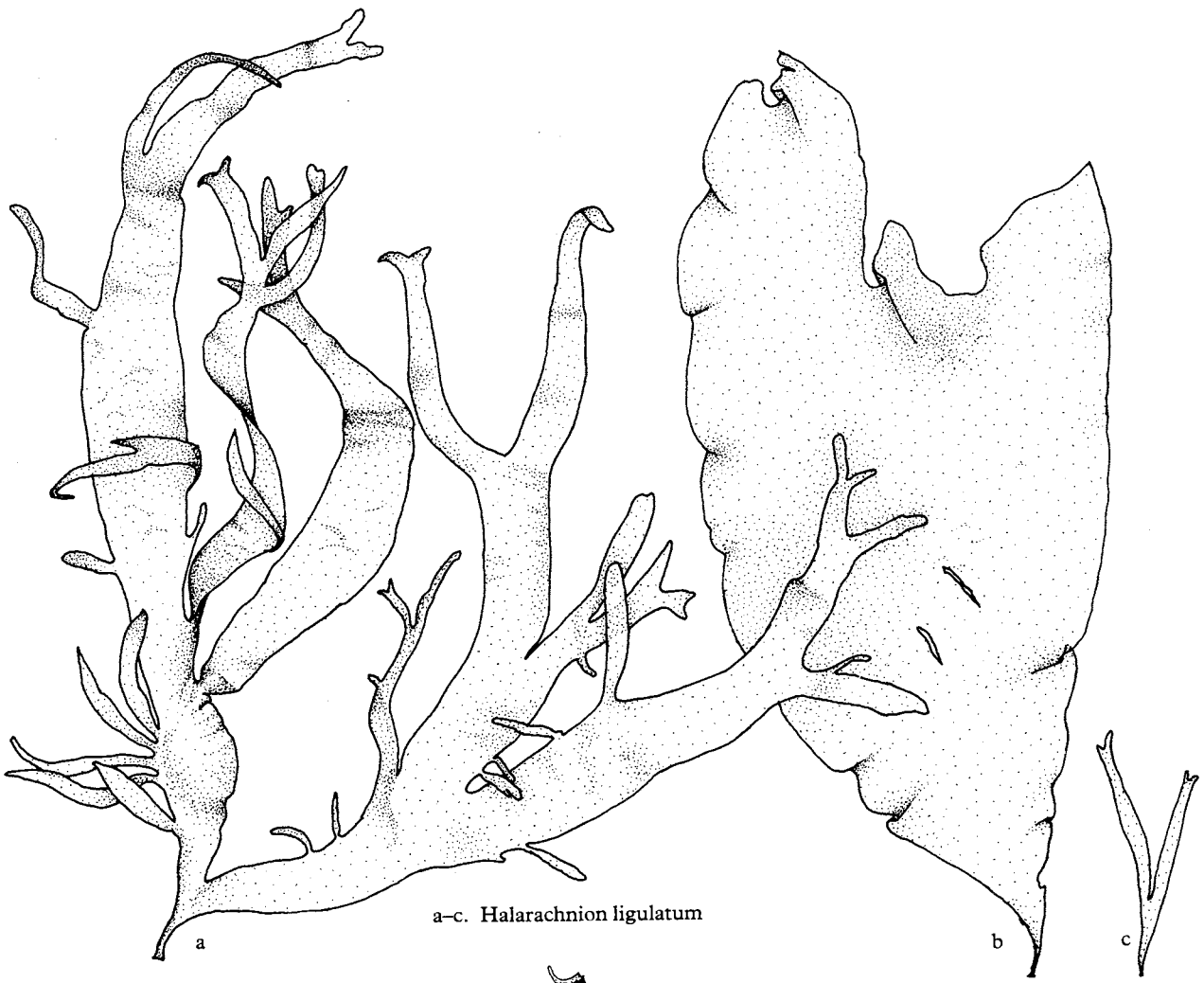


e. Cryptonemia hibernica (after Guiry and Irvine, 1974)

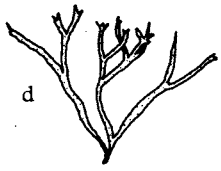


Grateloupia filicina var. luxurians

FIG. 15

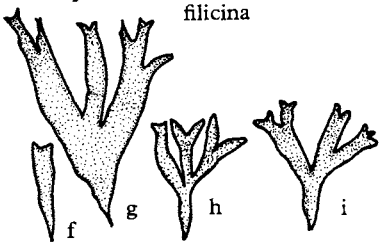


a–c. Halarachnion ligulatum

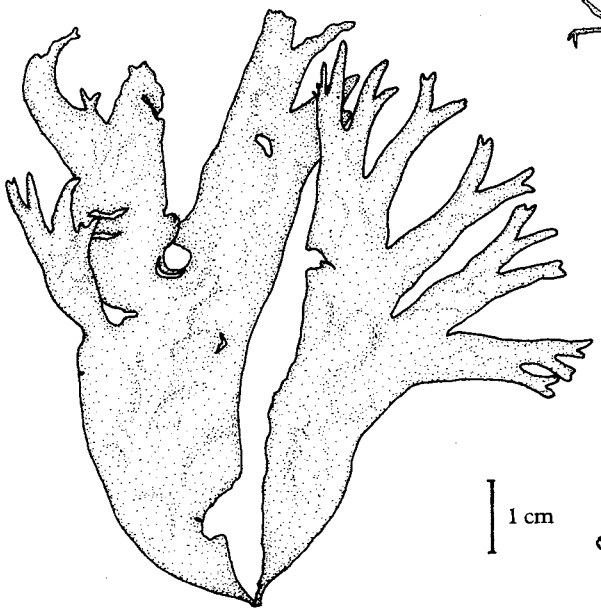


d. Platoma bairdii

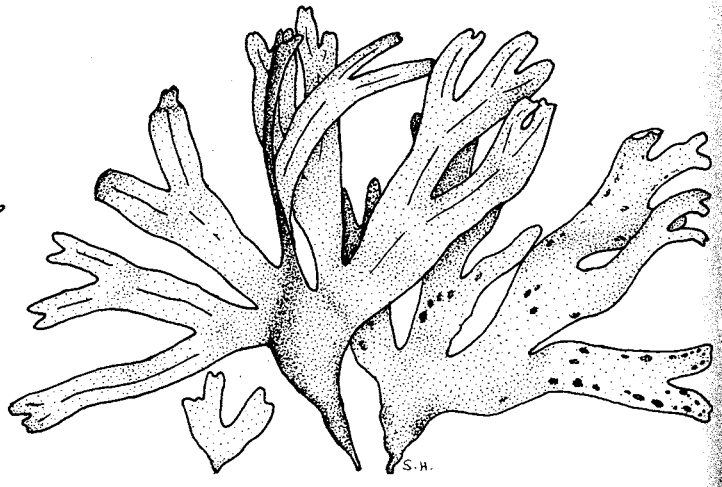
e. Grateloupia filicina var filicina



f–i. Grateloupia dichotoma

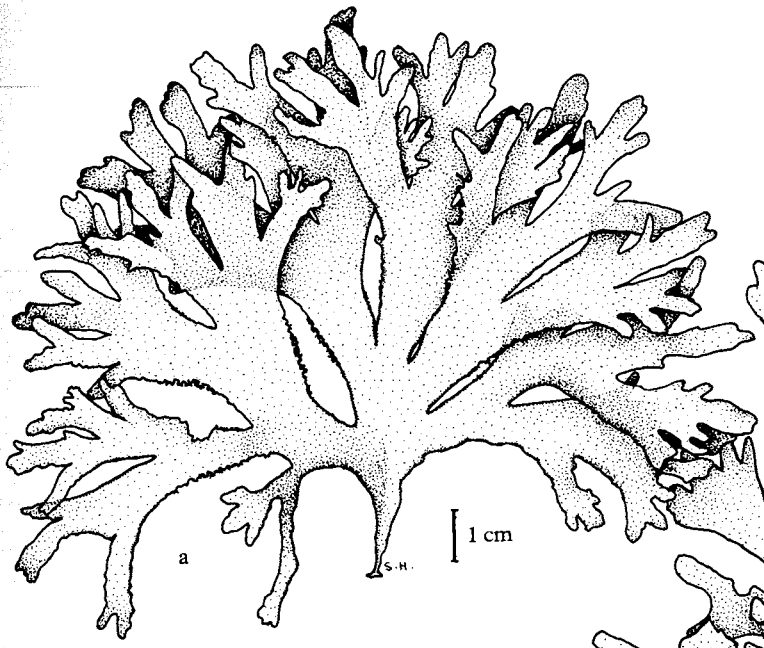


Platoma marginifera



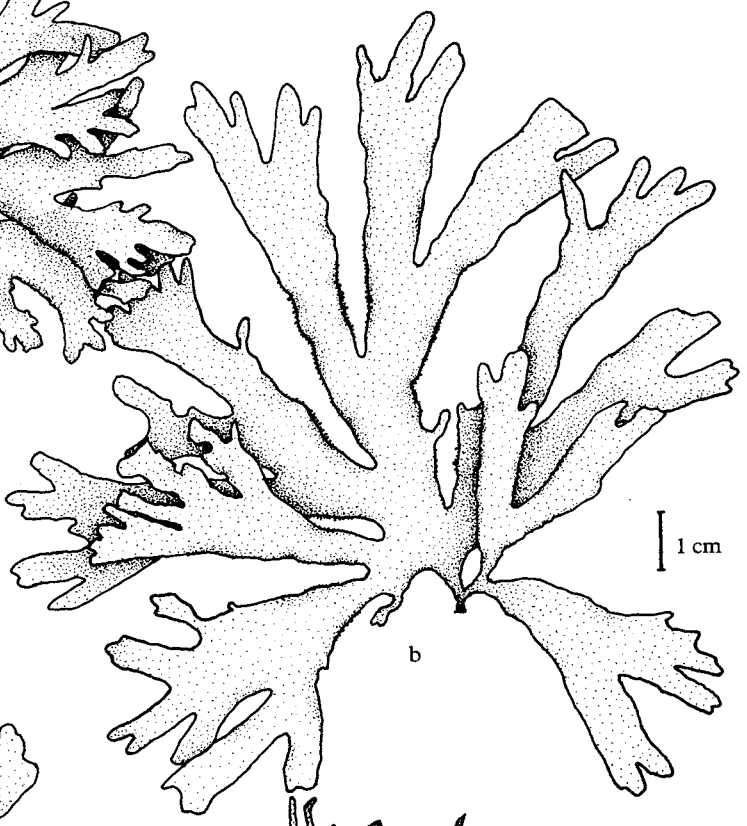
Stenogramme interrupta

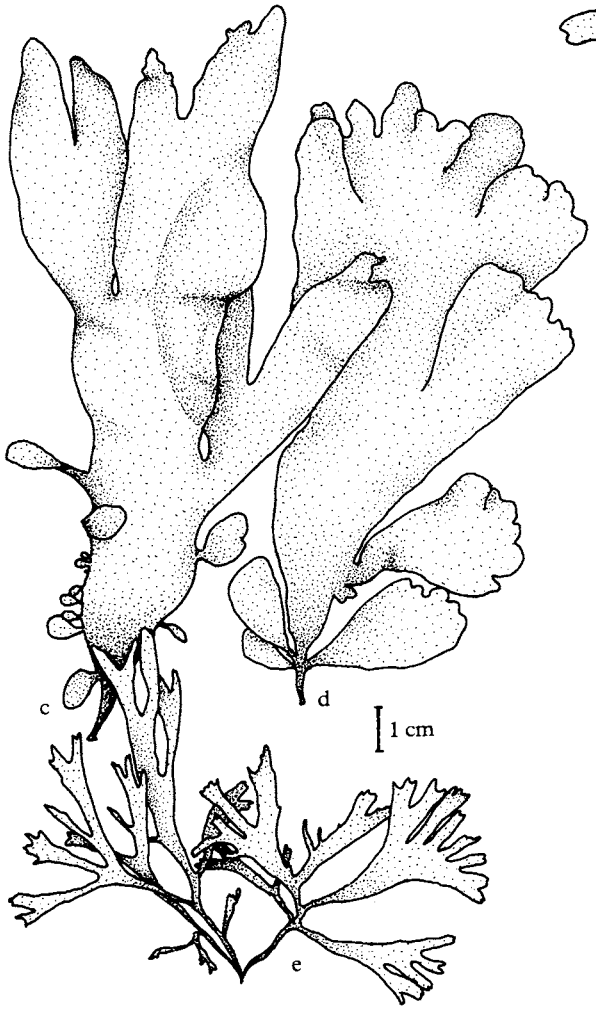
FIG. 16



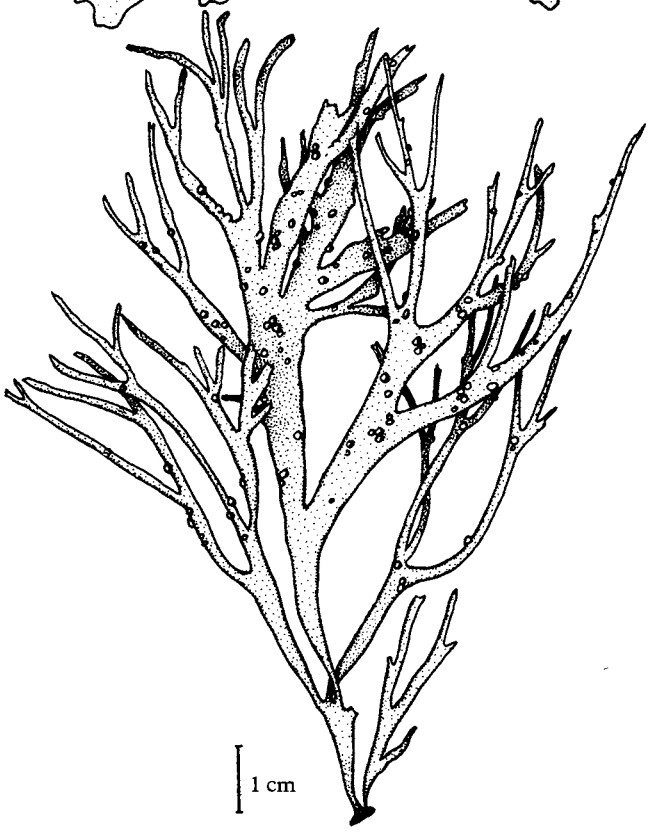
a. Callophyllis laciniata

b. Callophyllis flabellata



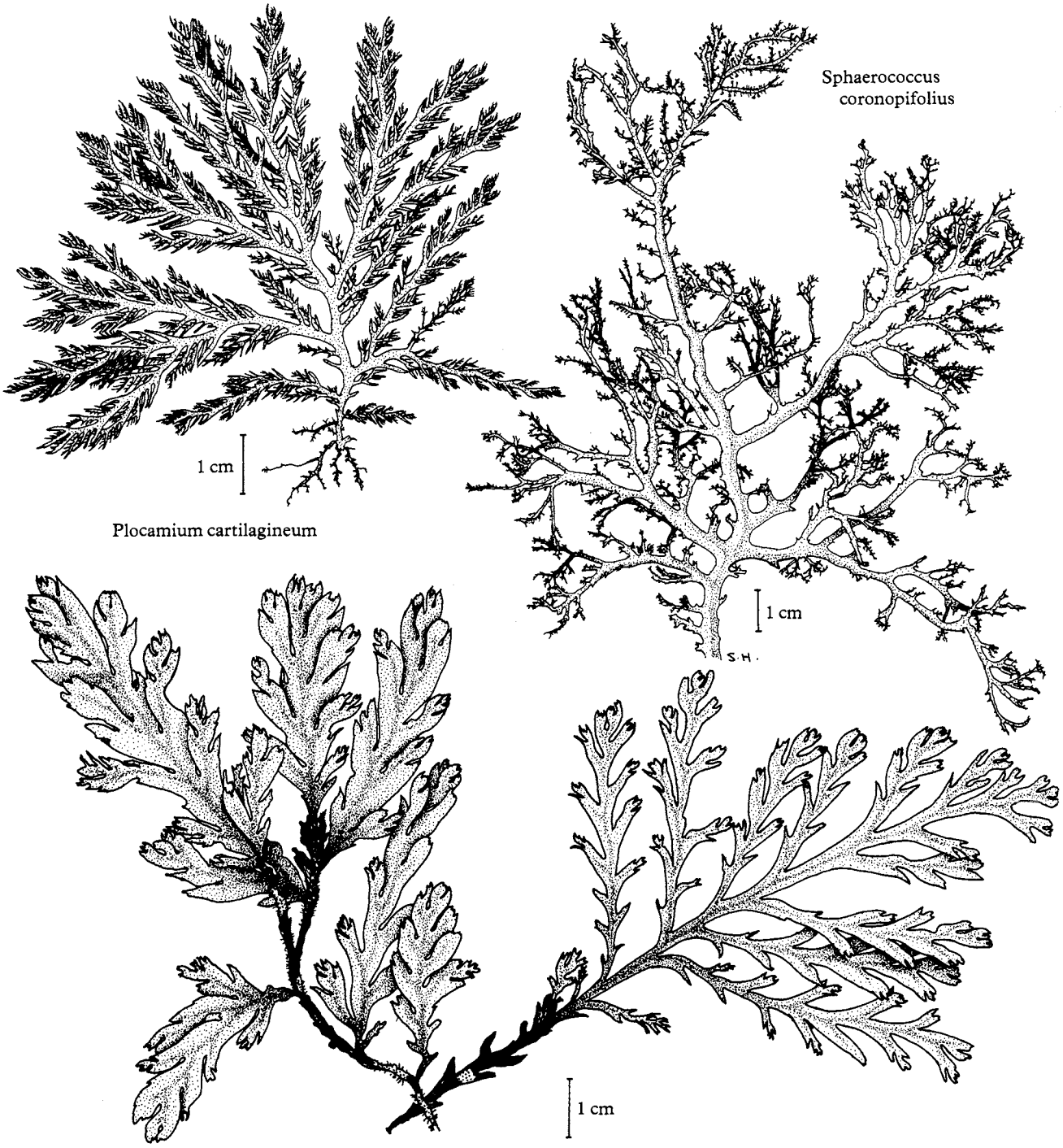


c–e. Palmaria palmata
DULSE, SHEEP'S WEED



Gracilaria foliifera

FIG. 17



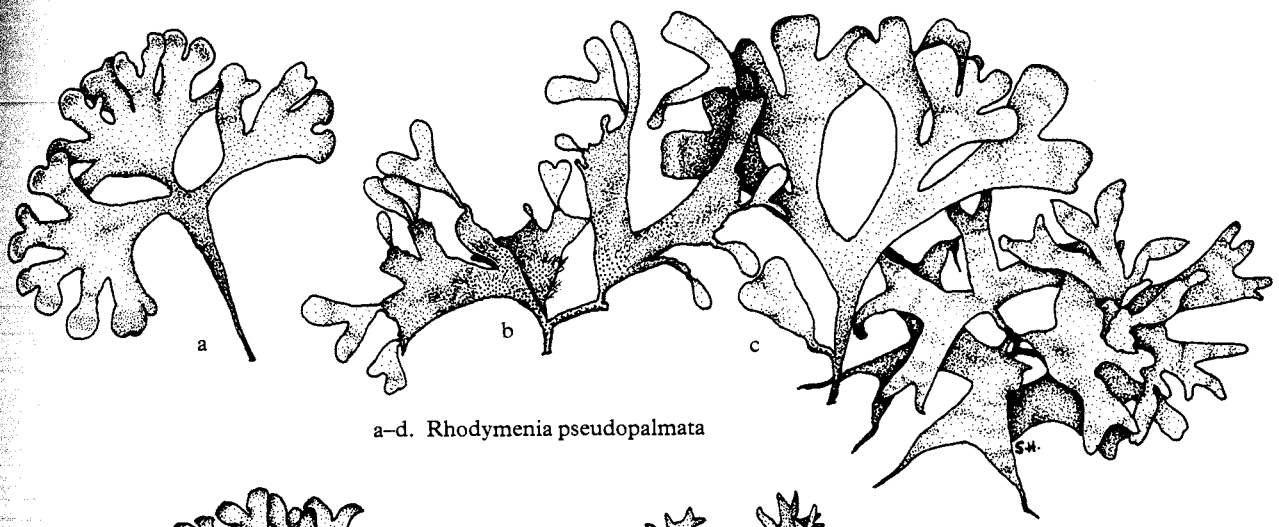
Plocamium cartilagineum

Odonthalia dentata

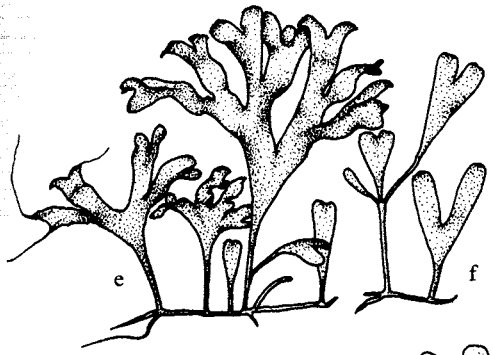
a–c. Schmitzia hiscockiana

Callophyllis cristata

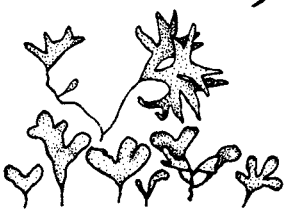
FIG. 18



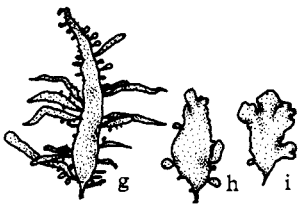
a–d. Rhodymenia pseudopalmata



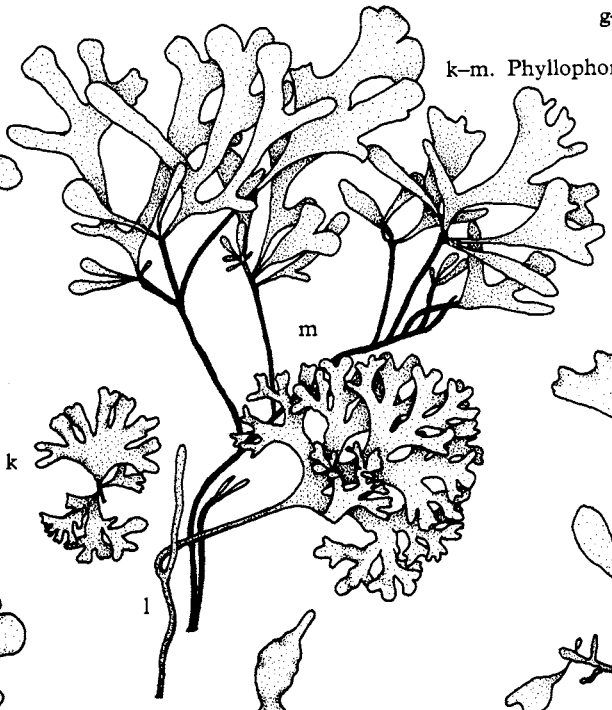
e–f. Rhodymenia holmesii



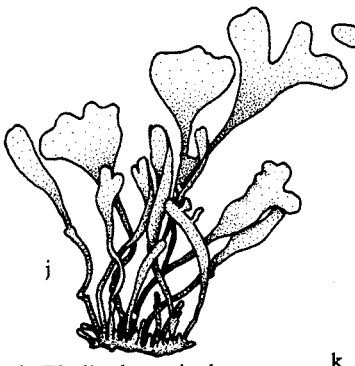
Rhodymenia delicatula



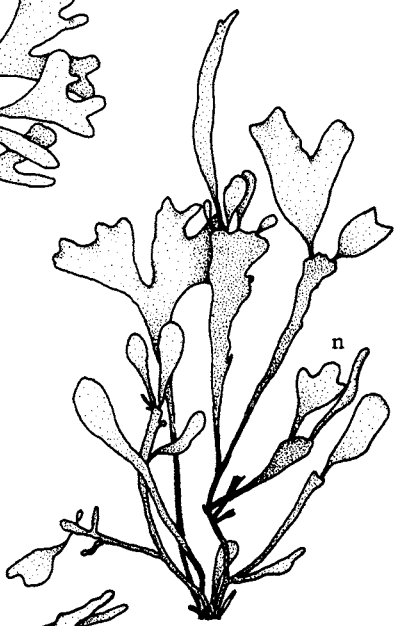
g–i. Phyllophora traillii



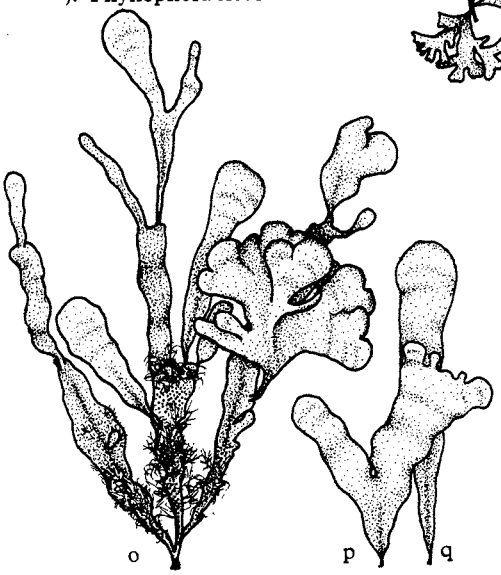
k–m. Phyllophora pseudoceranoides



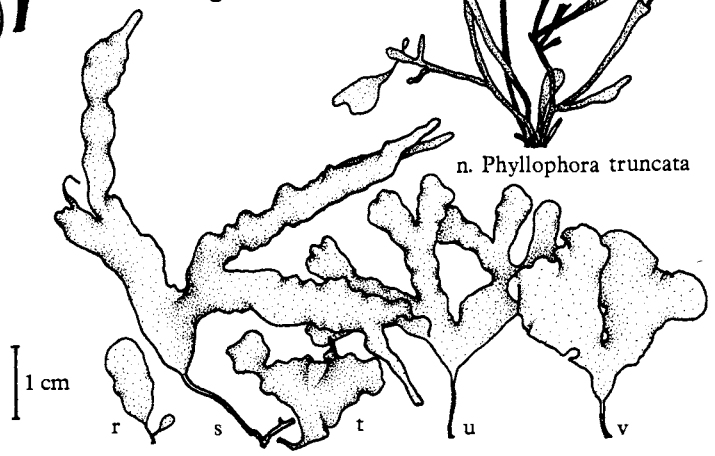
j. Phyllophora sicula



n. Phyllophora truncata

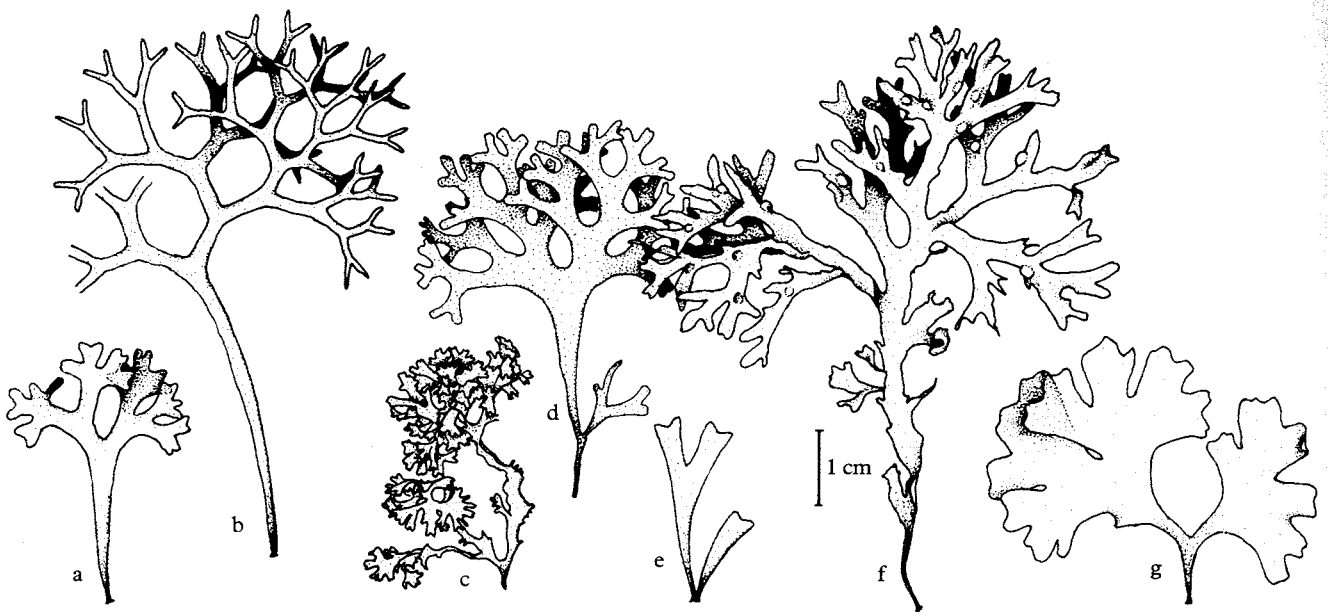


o–q. Phyllophora crispa

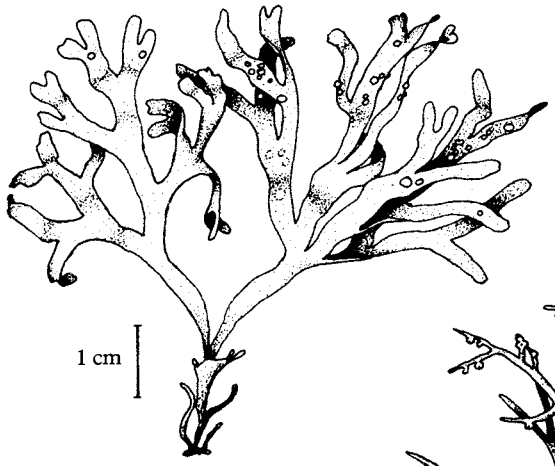


r–v. Schottera nicaeensis

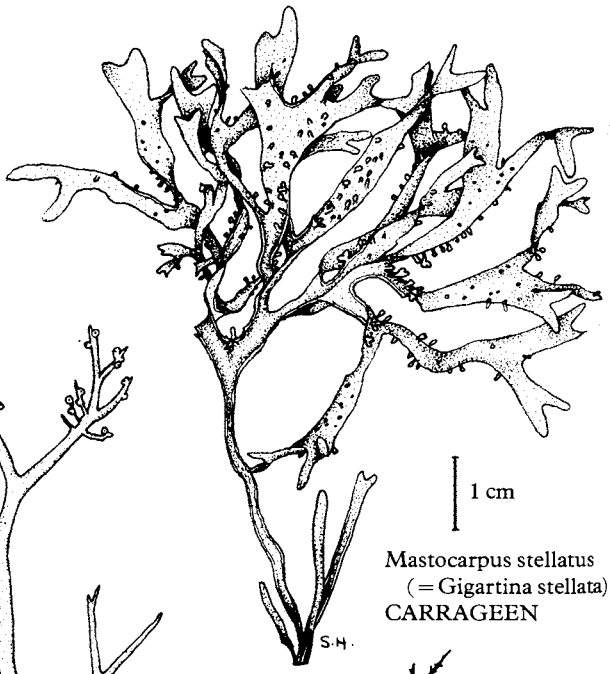
FIG. 19



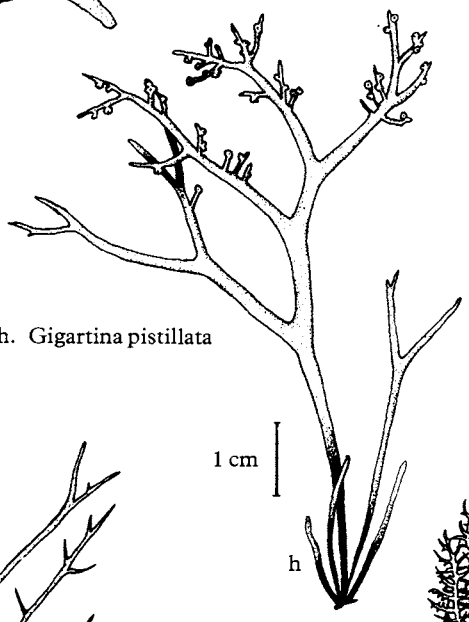
a–g. Chondrus crispus
CARRAGEEN



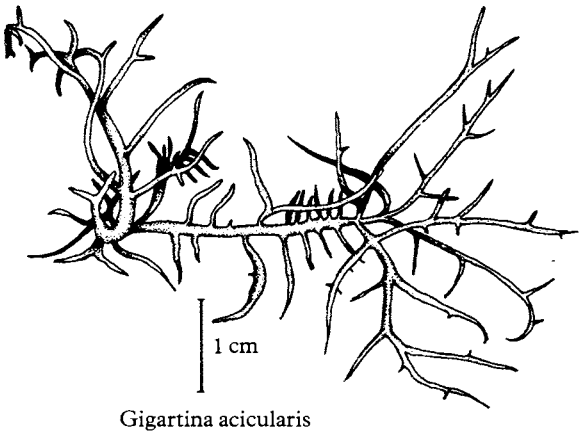
Gymnogongrus crenulatus



Mastocarpus stellatus
(= Gigartina stellata)
CARRAGEEN



h. Gigartina pistillata

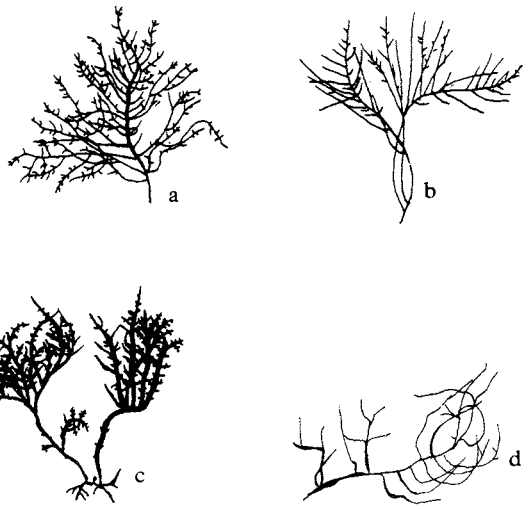


Gigartina acicularis

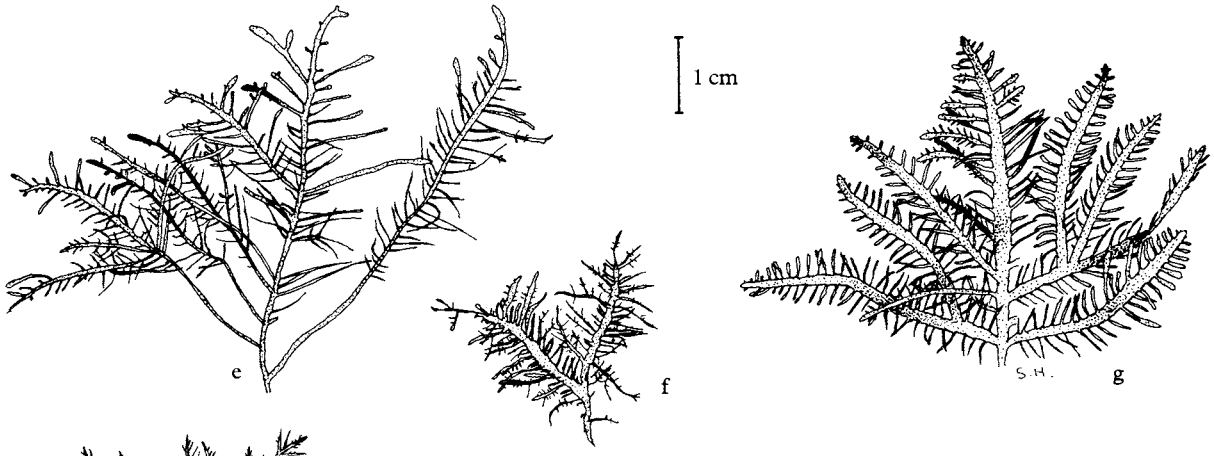
Gigartina teedii

FIG. 20

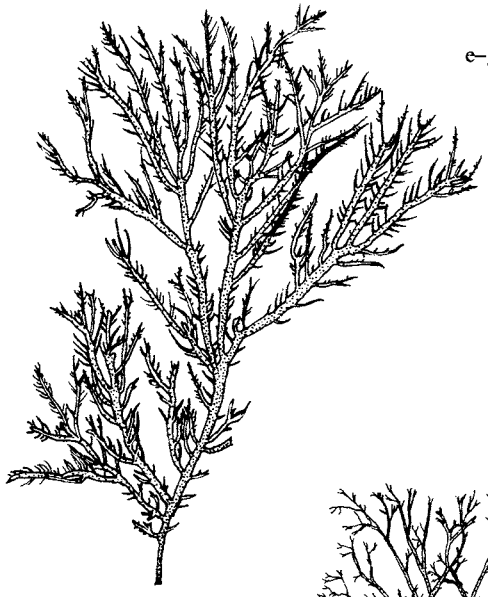
Pterocladia capillacea



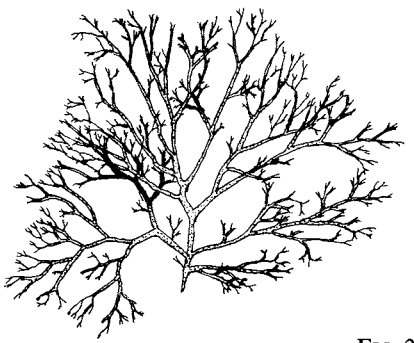
a–d. Gelidium pusillum



e–g. Gelidium latifolium



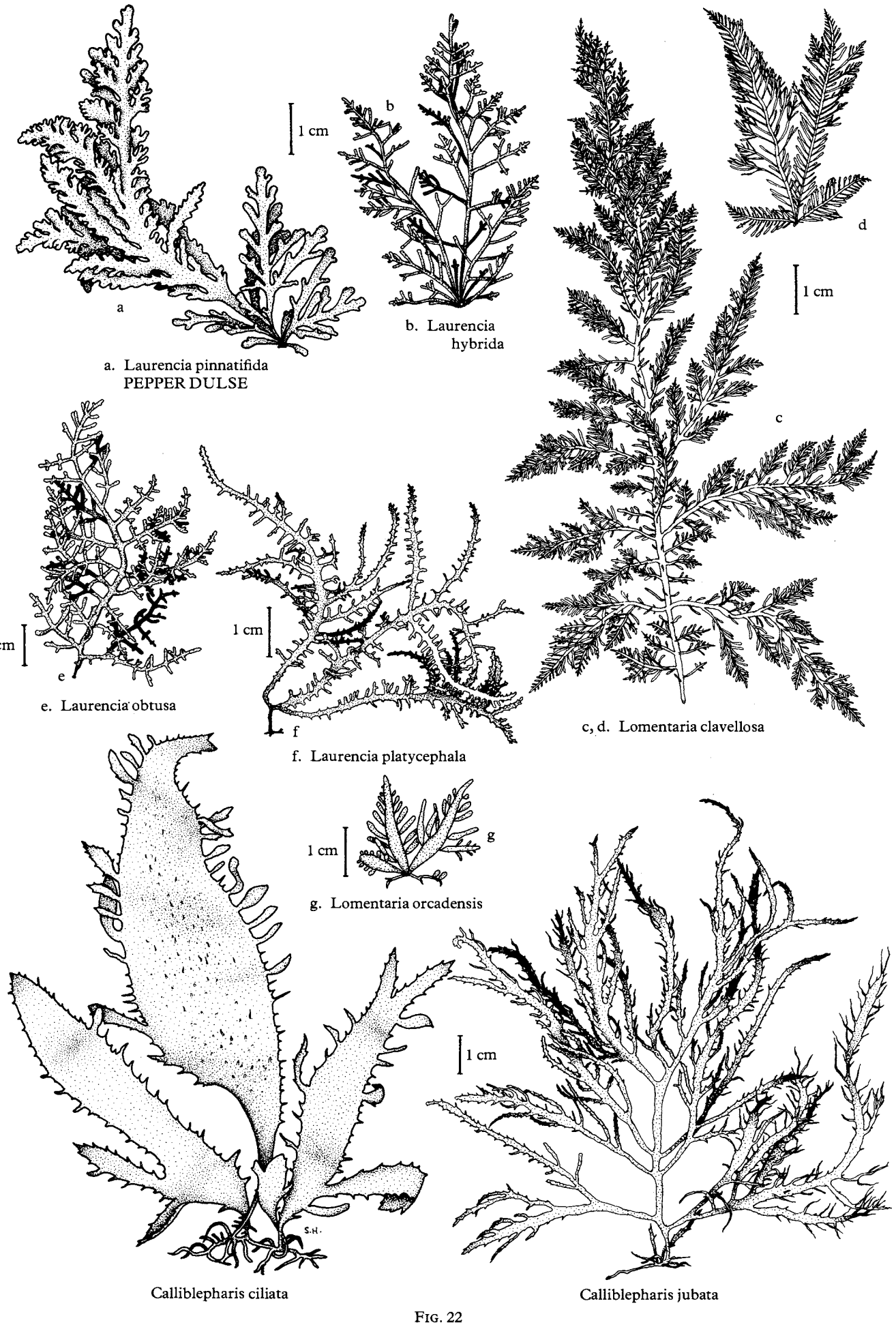
Pikea californica



Microcladia glandulosa

Gelidium sesquipedale
(after Dixon and Irvine, 1977)

FIG. 21



a. Laurencia pinnatifida
PEPPER DULSE

b. Laurencia hybrida

c, d. Lomentaria clavellosa

e. Laurencia obtusa

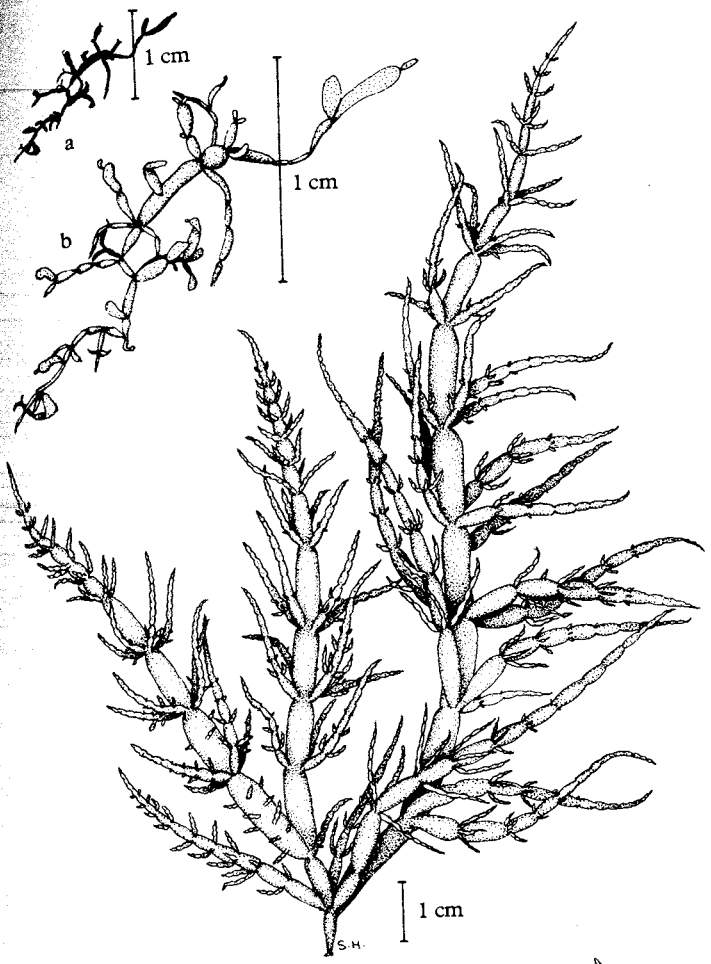
f. Laurencia platycephala

g. Lomentaria orcadensis

Calliblepharis ciliata

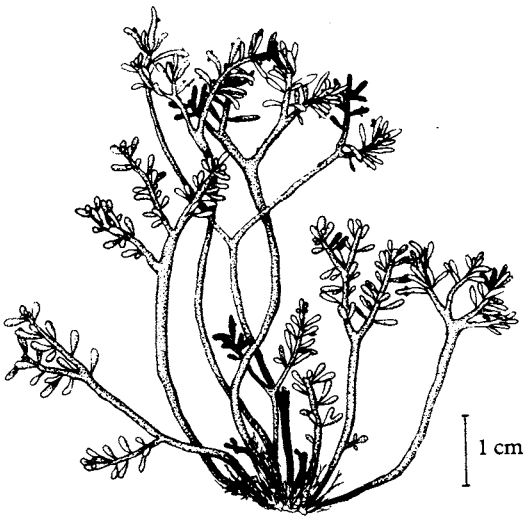
Calliblepharis jubata

FIG. 22



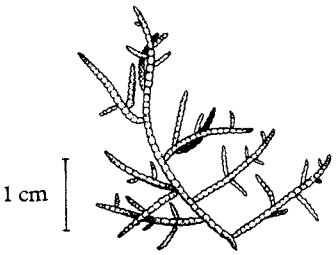
Chylocladia verticillata

a, b. Catenella caespitosa

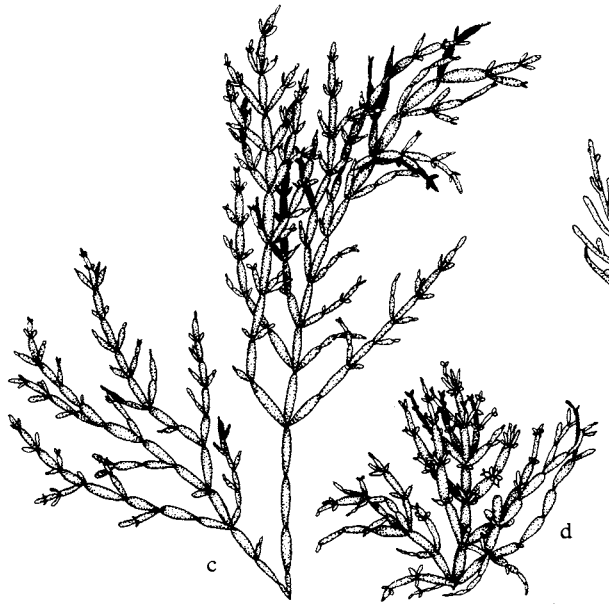


Gastroclonium ovatum

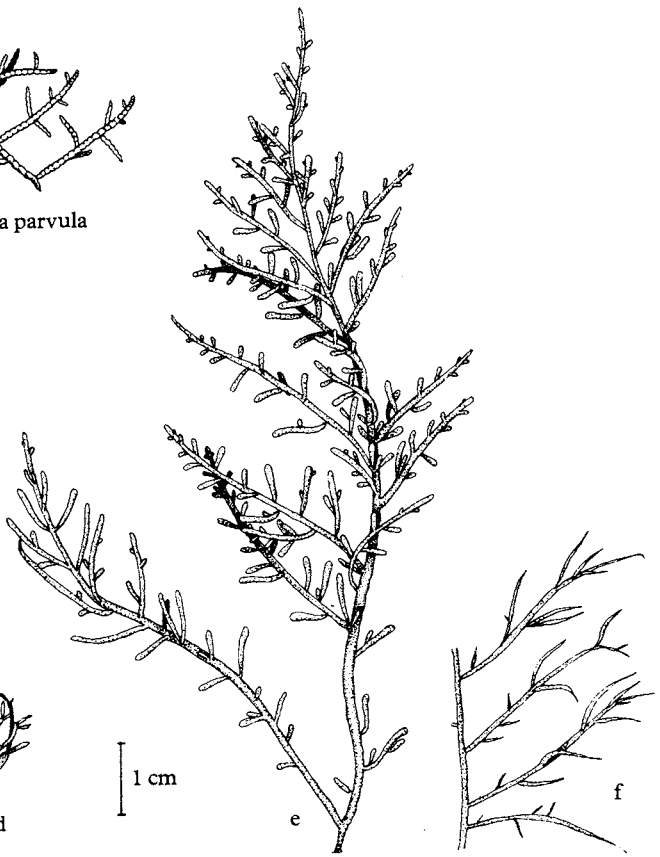
Gastroclonium reflexum



Champia parvula



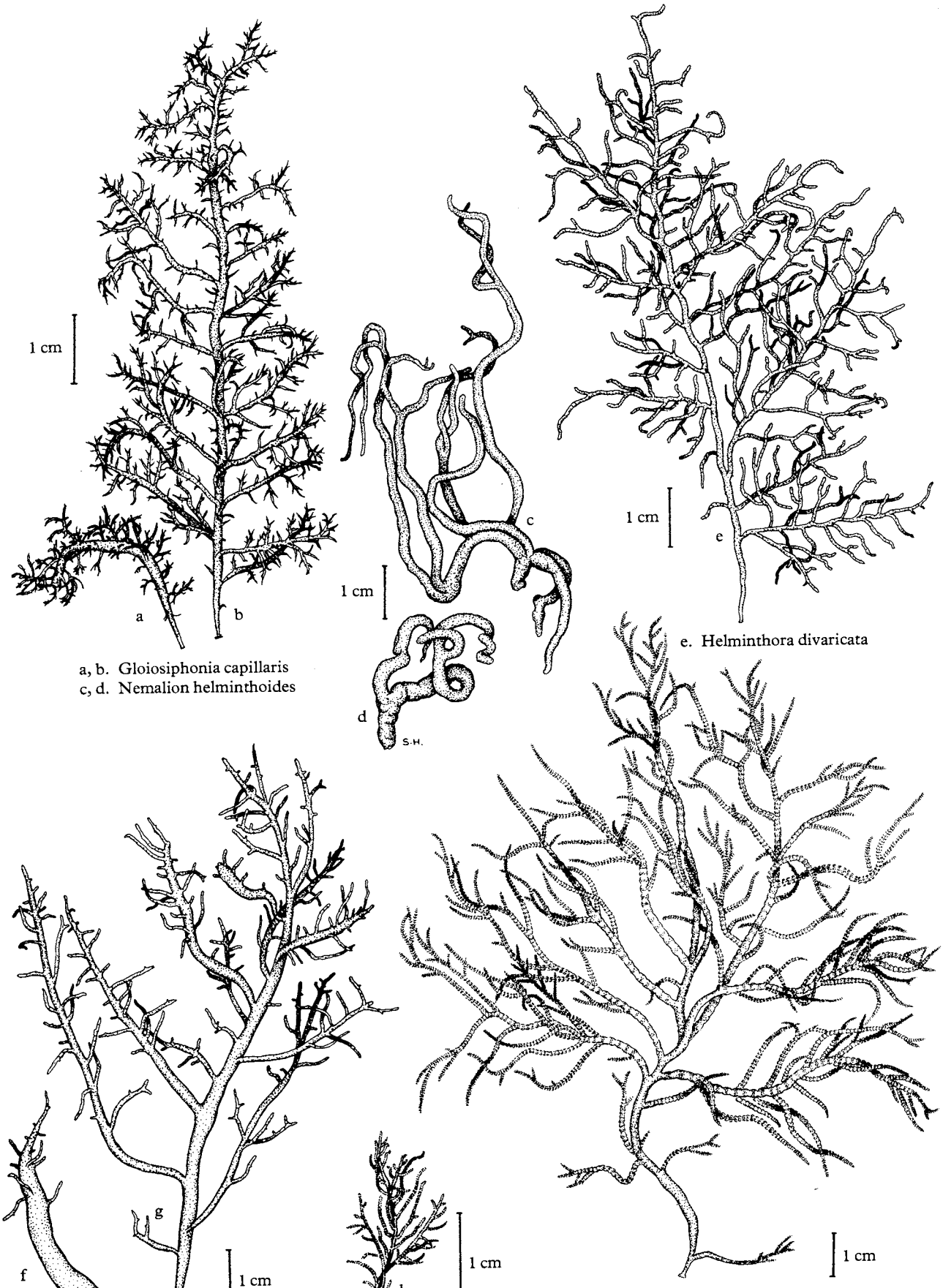
c, d. Lomentaria articulata



e. Chondria dasyphylla

f. Chondria tenuissima (part)

FIG. 23



a, b. Gloiosiphonia capillaris
c, d. Nemalion helminthoides

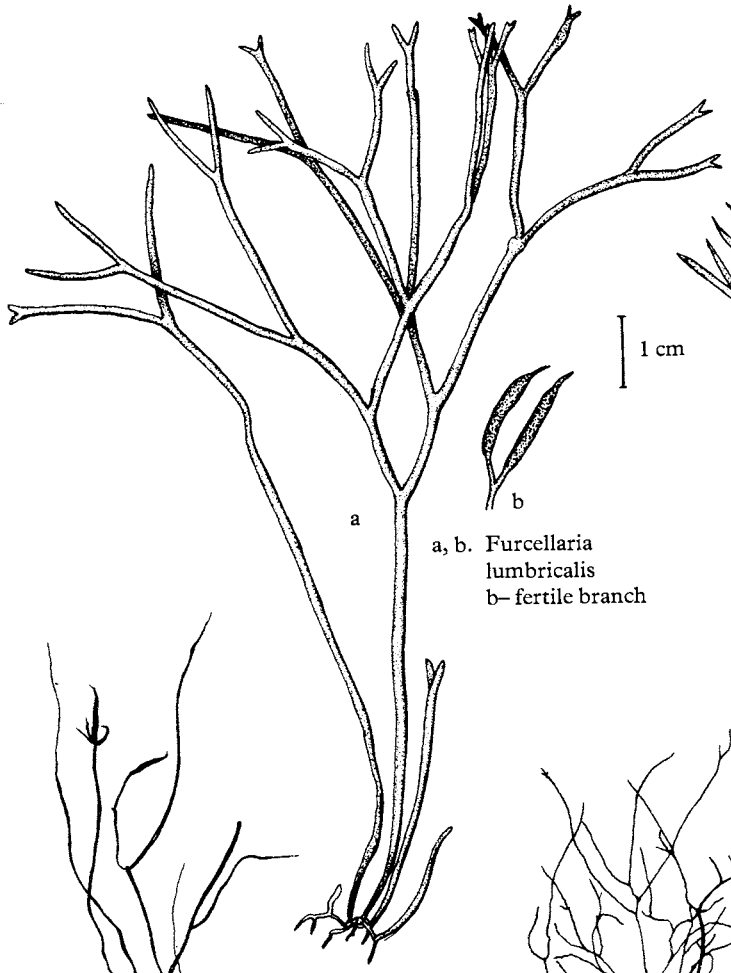
e. Helminthora divaricata

f, g. Helminthocladia calvadosii

h. Calosiphonia vermicularis and Schmitzia neapolitana

i. Dudresnaya verticillata

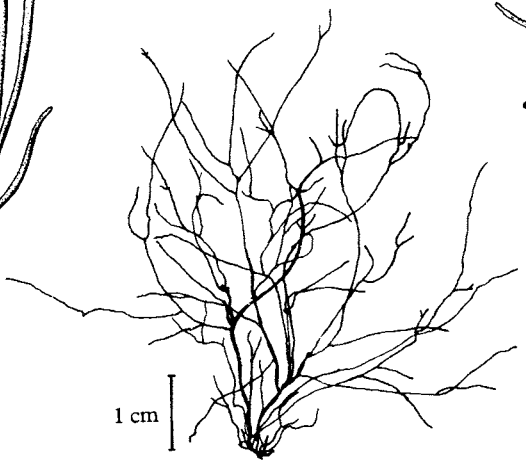
FIG. 24



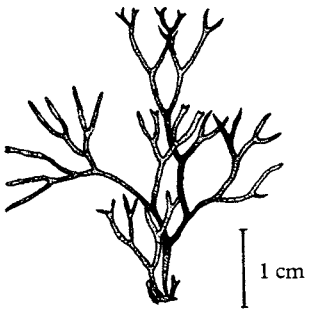
a, b. Furcellaria lumbricalis
b– fertile branch

c, d. Polyides rotundus
d– fertile branch

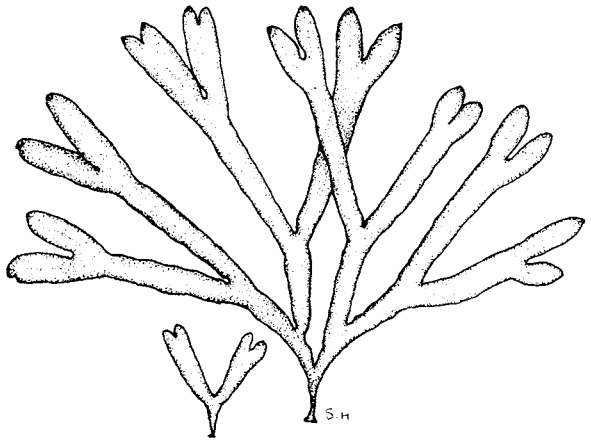
Cordylecladia erecta



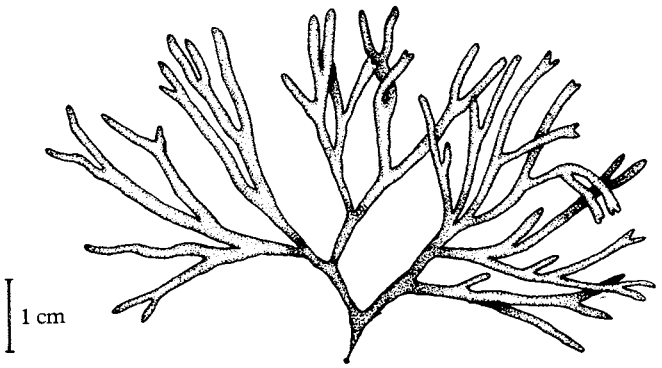
Ahnfeltia plicata



Gymnogongrus griffithsiae

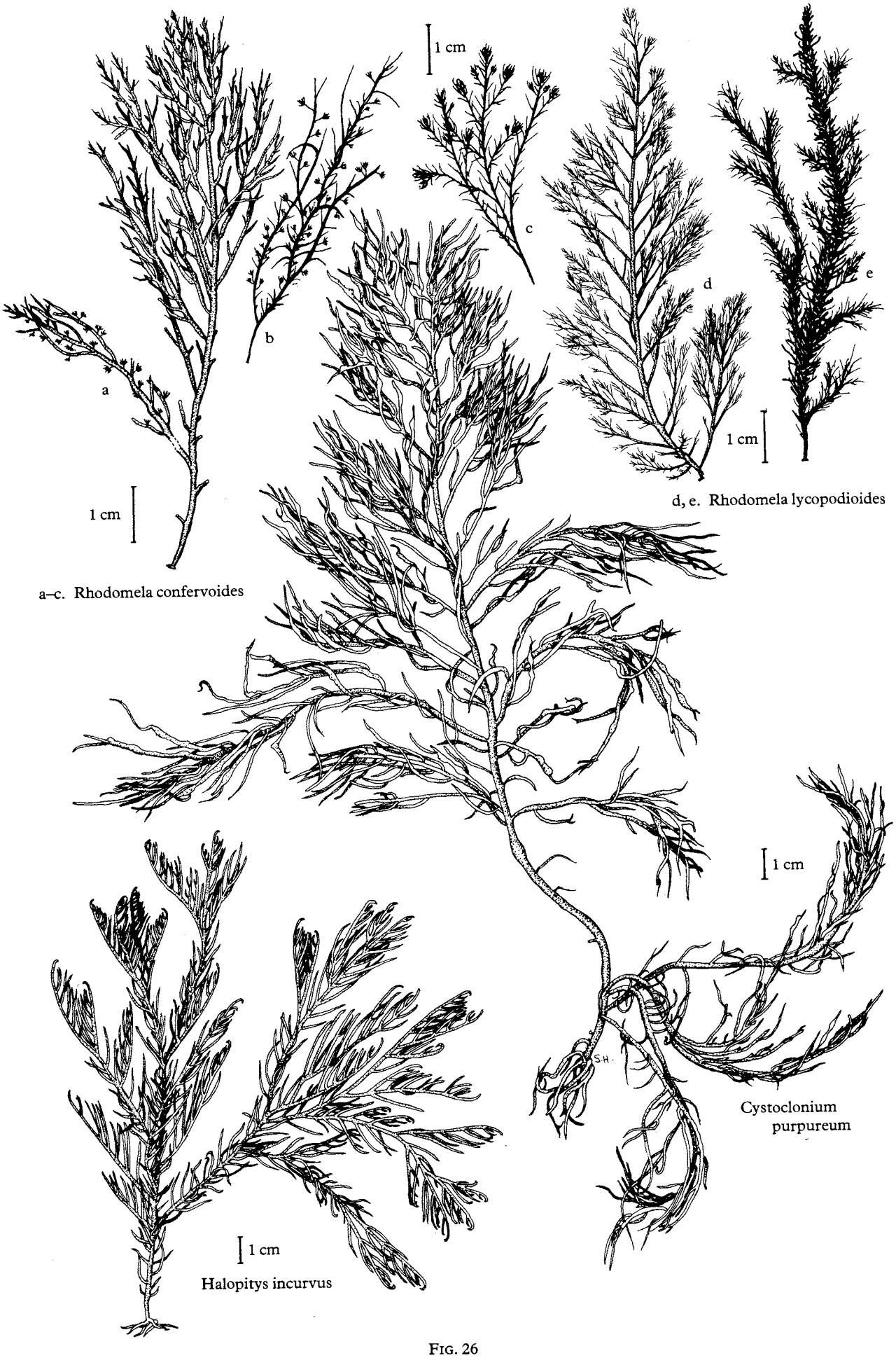


Scinaia turgida



Scinaia forcellata subsp. forcellata

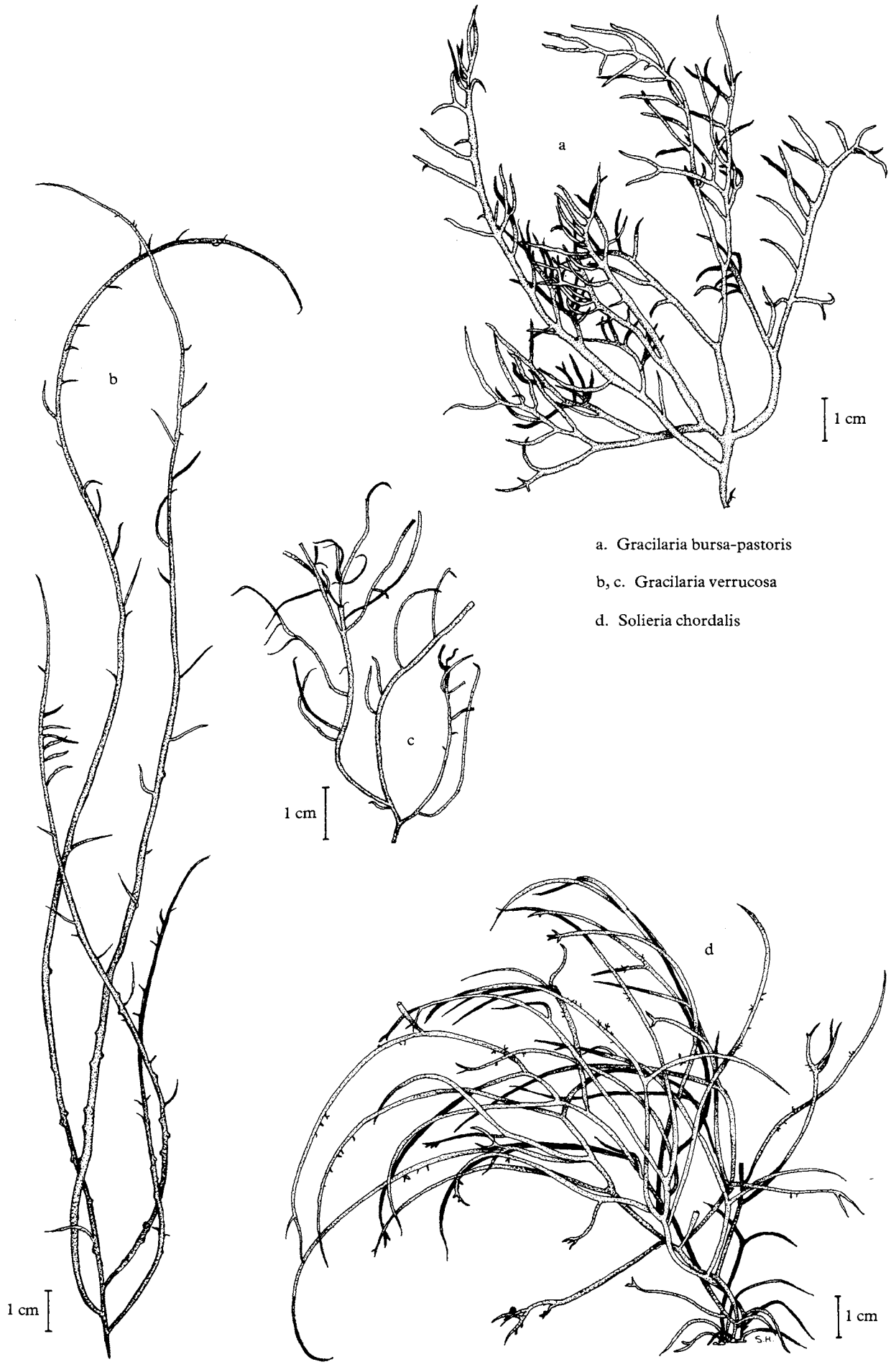
FIG. 25



a–c. Rhodomela confervoides

d, e. Rhodomela lycopodioides

FIG. 26

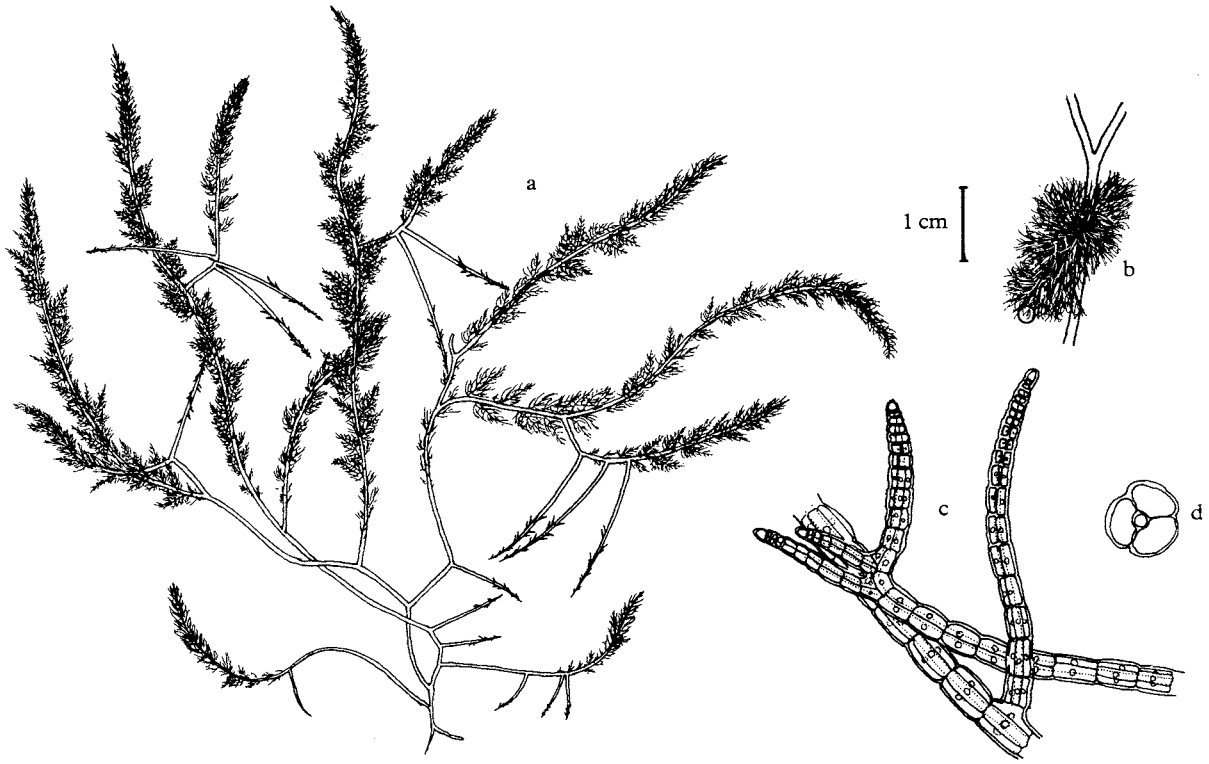


a. Gracilaria bursa-pastoris

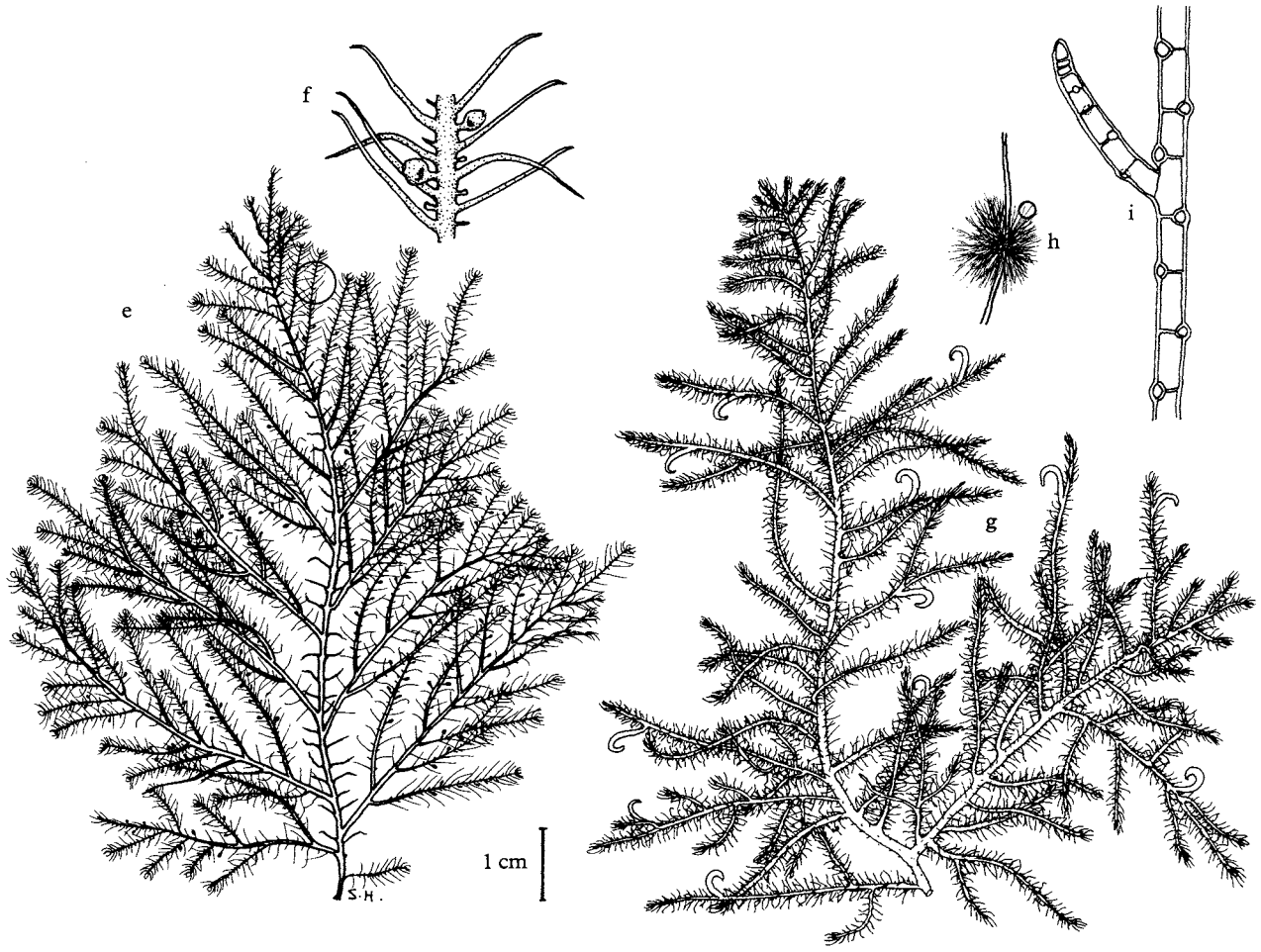
b, c. Gracilaria verrucosa

d. Solieria chordalis

FIG. 27



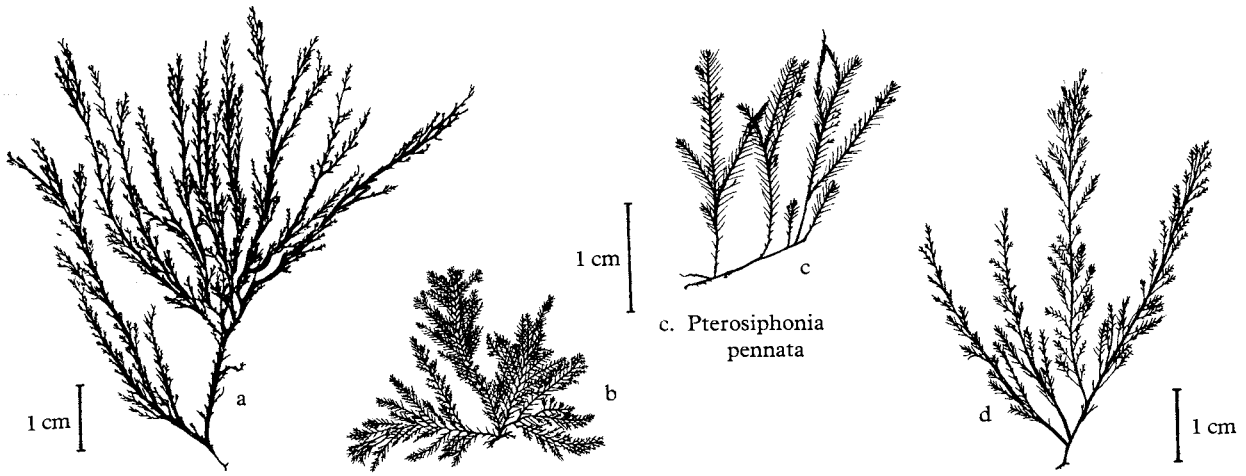
a–d. Asparagopsis armata: a–gametophyte; b–sporophyte ('Falkenbergia'); c–enlarged detail of b; d–cross section of c



e, f. Bonnemaisonia asparagoides
f–enlarged detail of e

g–i. Bonnemaisonia hamifera. g–gametophyte;
h–sporophyte ('Trailliella'); i–enlarged detail of h

FIG. 28

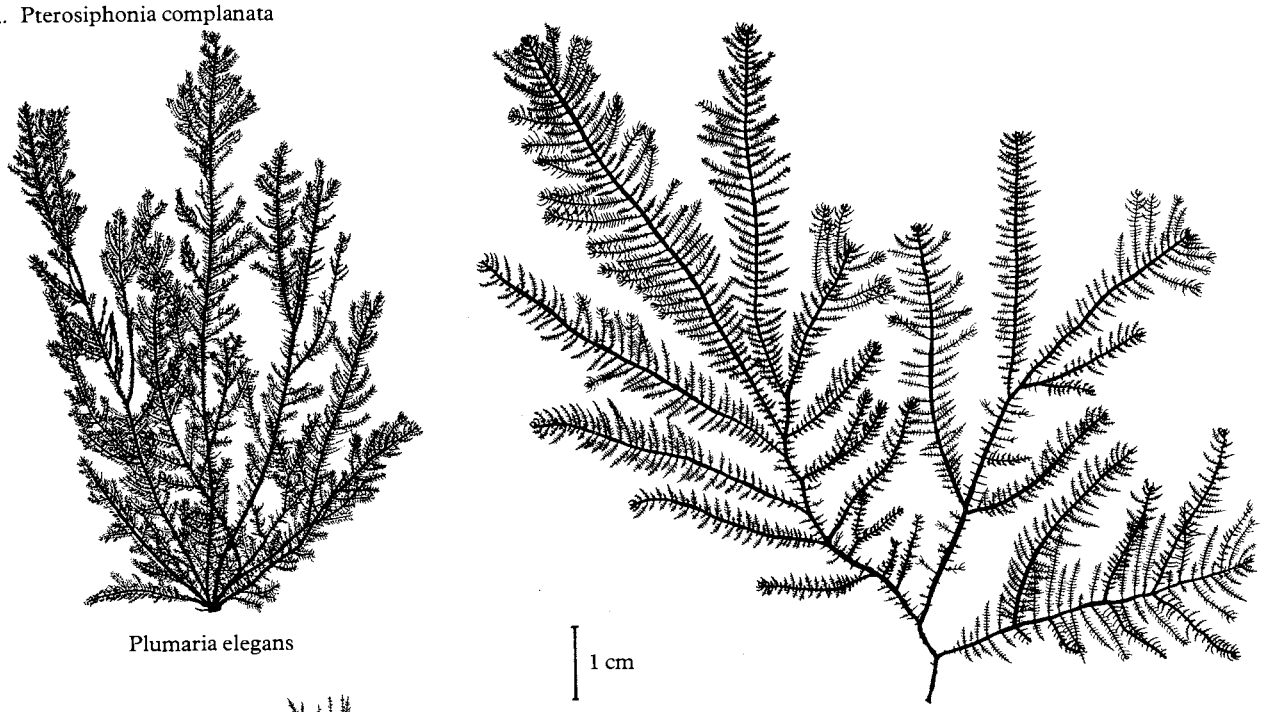


a. Pterosiphonia complanata

b. Pterosiphonia parasitica

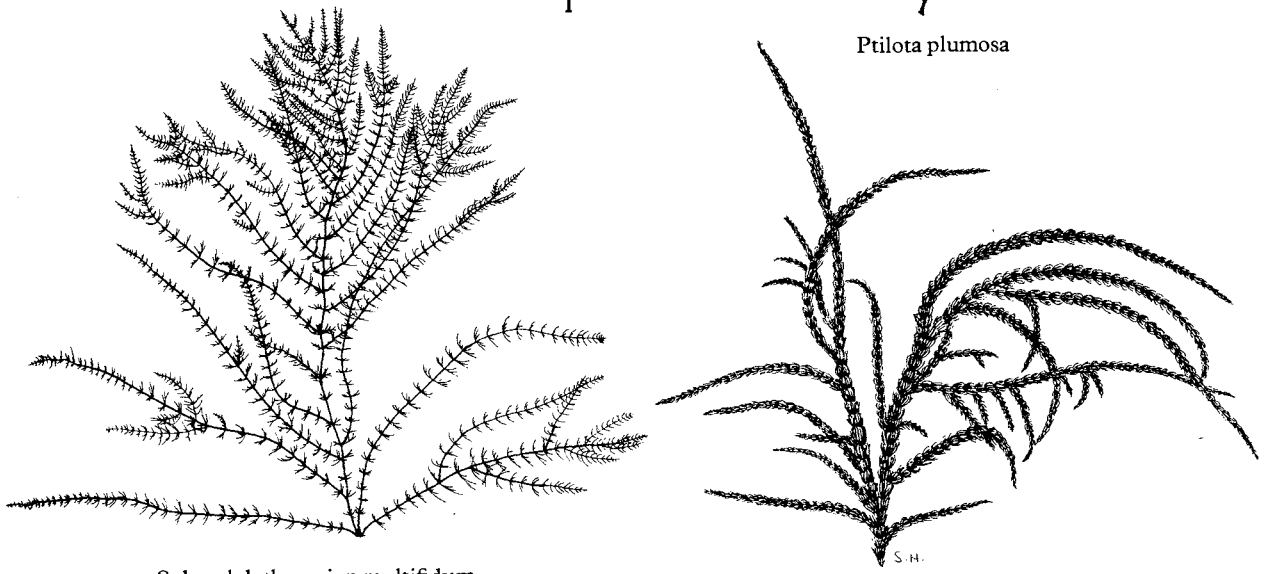
c. Pterosiphonia pennata

d. Pterosiphonia thuyoides



Plumaria elegans

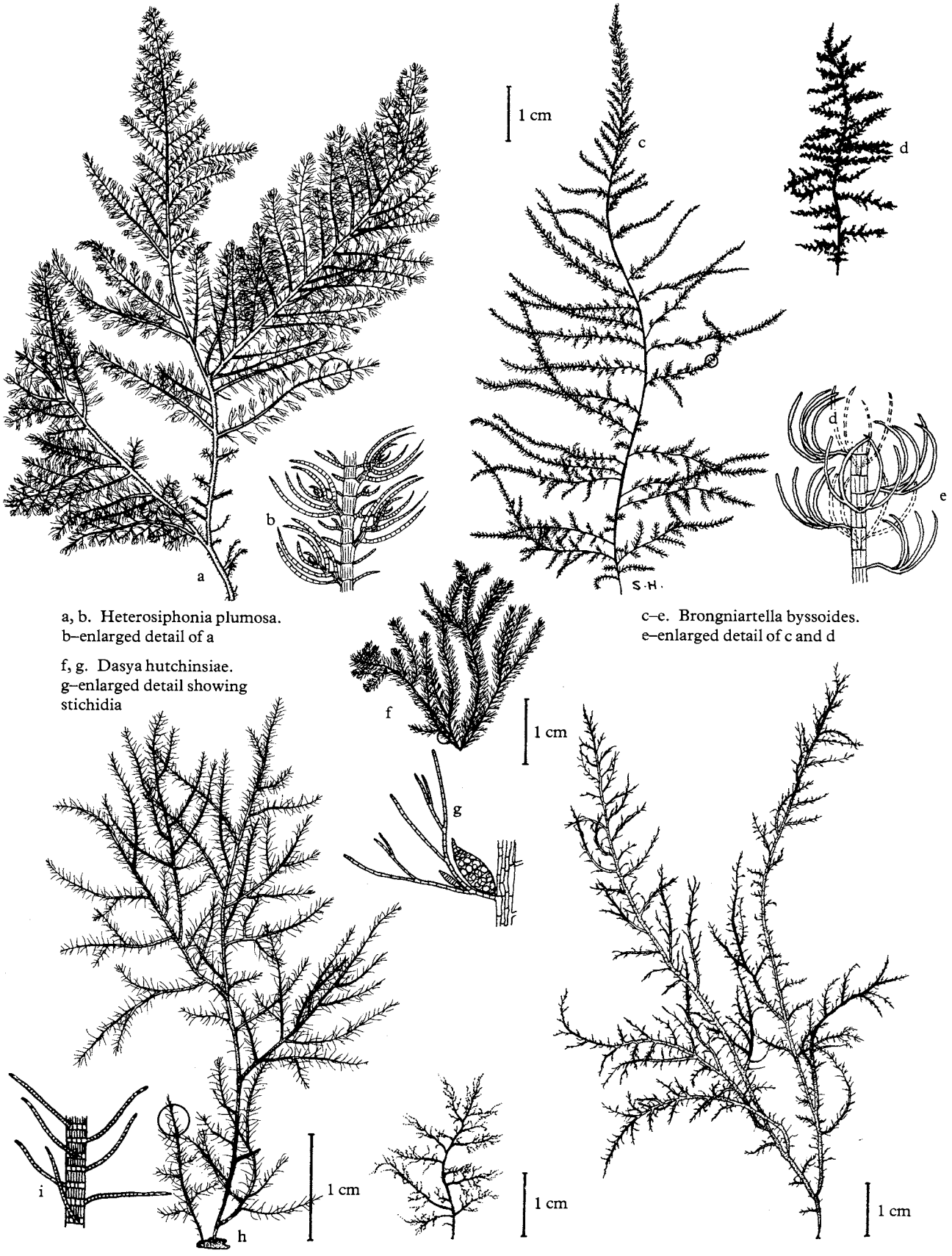
Ptilota plumosa



Sphondylothamnion multifidum

Halurus equisetifolius

FIG. 29



a, b. Heterosiphonia plumosa.
b–enlarged detail of a

c–e. Brongniartella byssoides.
e–enlarged detail of c and d

f, g. Dasya hutchinsiae.
g–enlarged detail showing stichidia

h, i. Spyridia filamentosa.
i–enlarged detail of h

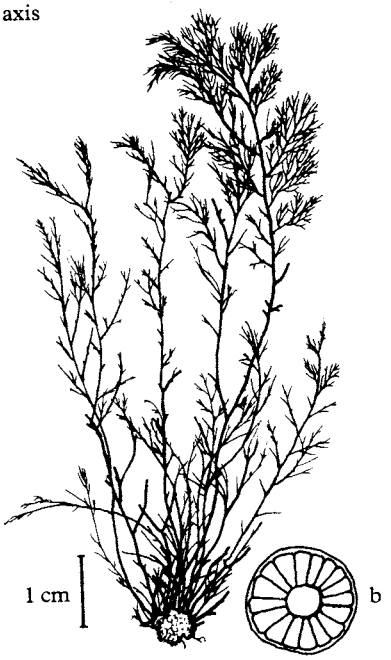
Atractophora hypnoides

Naccaria wiggii

FIG. 30

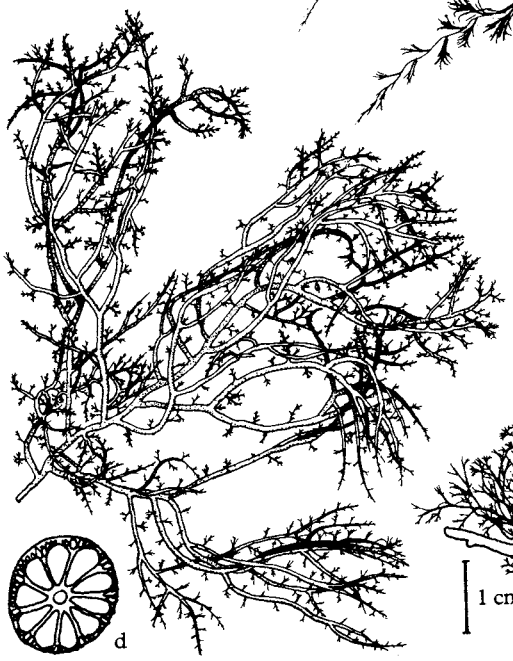
a–f are cross sections of main axis

Polysiphonia elongata

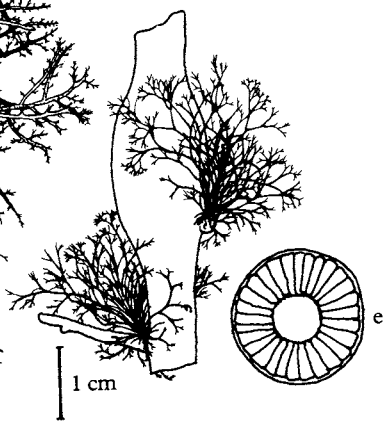


Polysiphonia nigrescens

Polysiphonia brodiaei



Polysiphonia fruticulosa

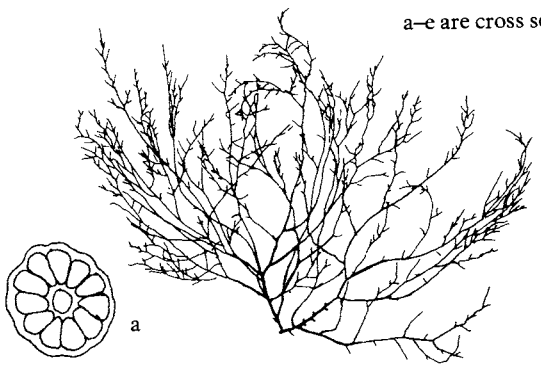


Polysiphonia lanosa
(on Ascophyllum nodosum)

Polysiphonia nigra

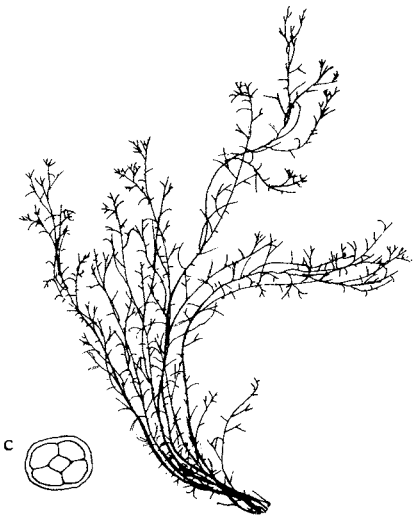
FIG. 31

a–e are cross sections of main axis



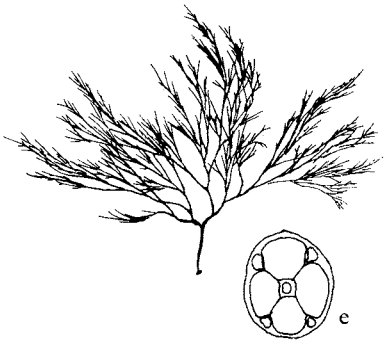
Polysiphonia simulans

Polysiphonia foetidissima

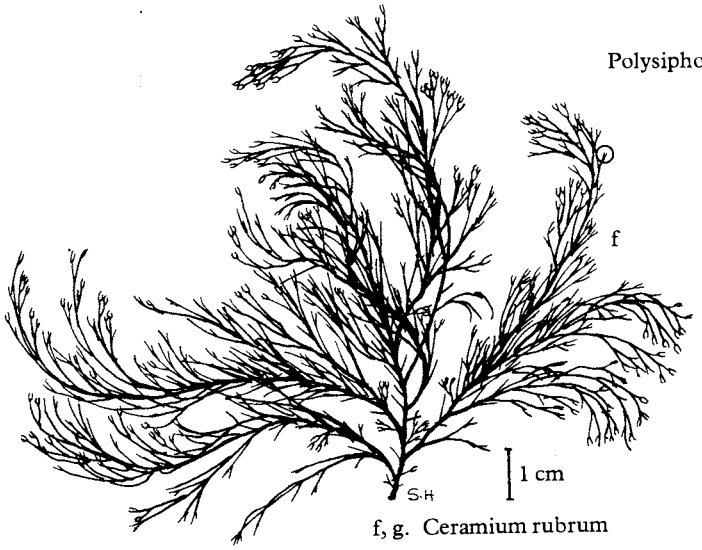


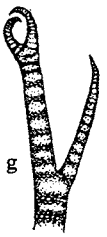
Polysiphonia urceolata

Polysiphonia macrocarpa



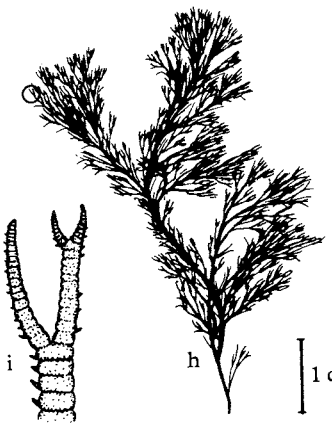
Polysiphonia violacea



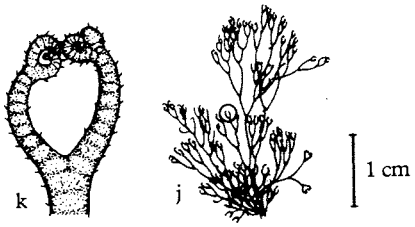


f, g. Ceramium rubrum

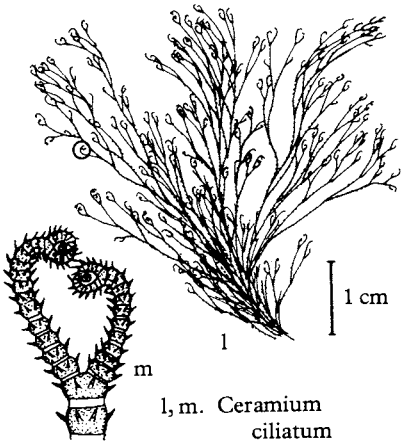
g, i, k, m, o are details of branches at apices



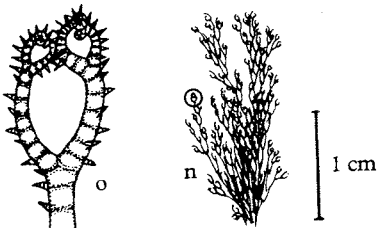
h, i. Ceramium flabelligerum



j, k. Ceramium echionotum



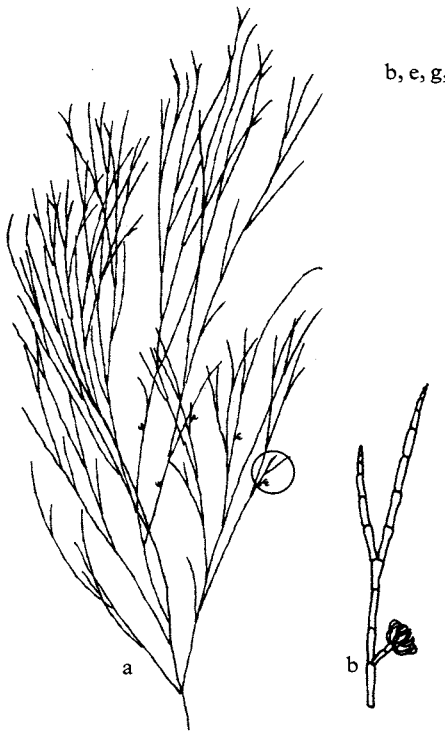
l, m. Ceramium ciliatum



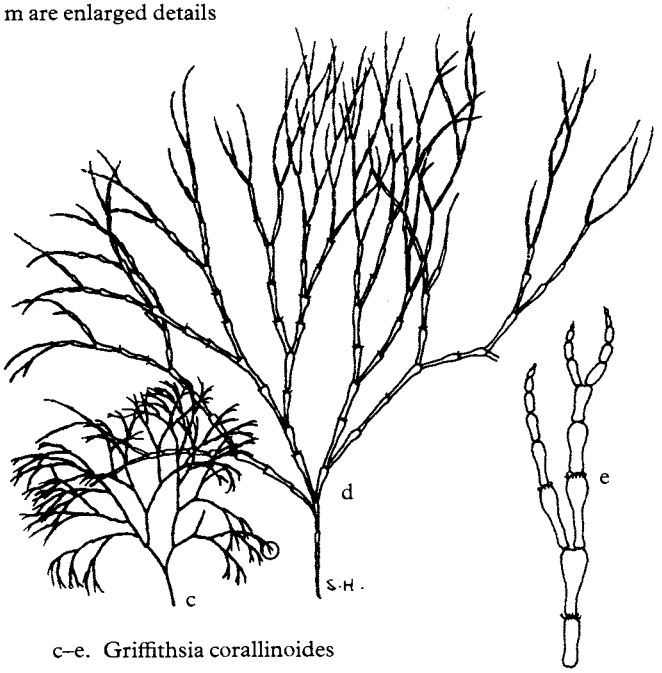
n, o. Ceramium shuttleworthianum

FIG. 32

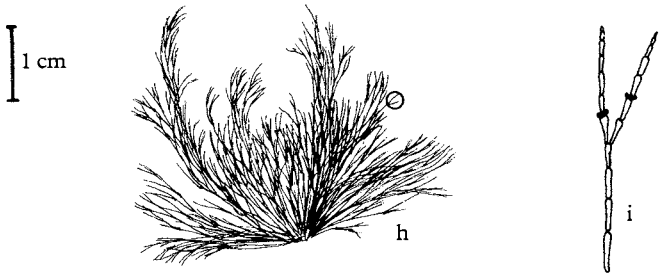
b, e, g, i, k and m are enlarged details



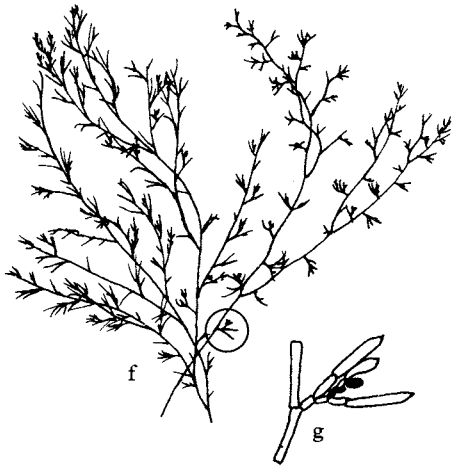
a, b. Griffithsia flosculosa



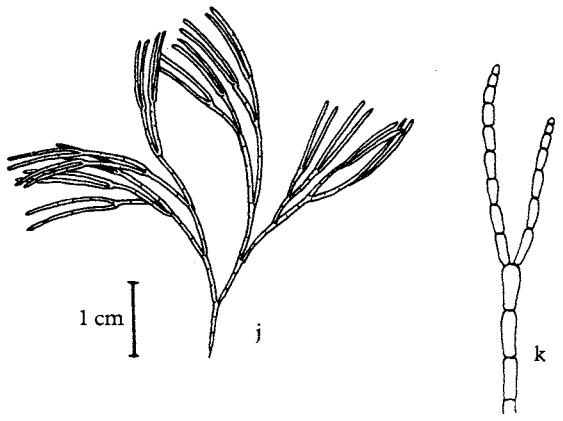
c–e. Griffithsia corallinoides



h, i. Griffithsia devonienis



f, g. Corynospora pedicellata

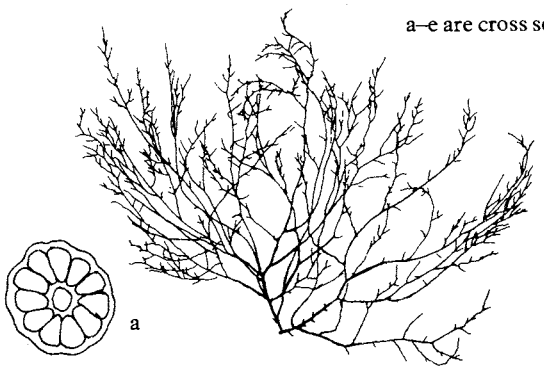


j, k. Bornetia secundiflora

l, m. Bostrychia scorpioides

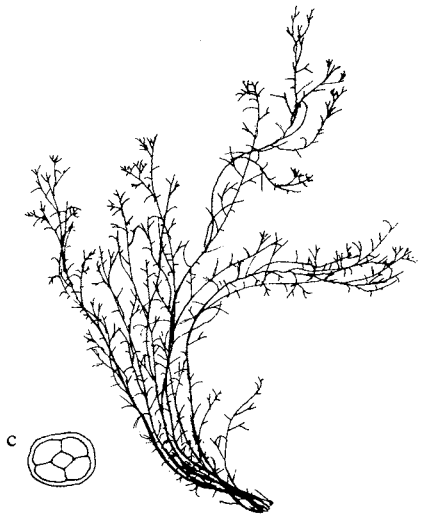
FIG. 33

a–e are cross sections of main axis



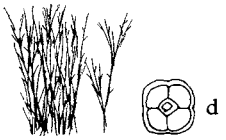
Polysiphonia simulans

Polysiphonia foetidissima

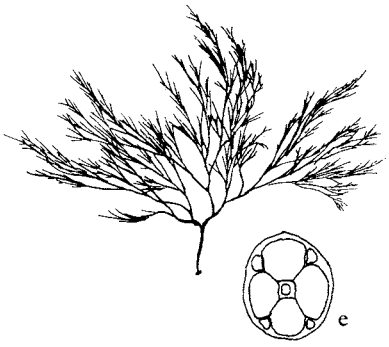


Polysiphonia urceolata

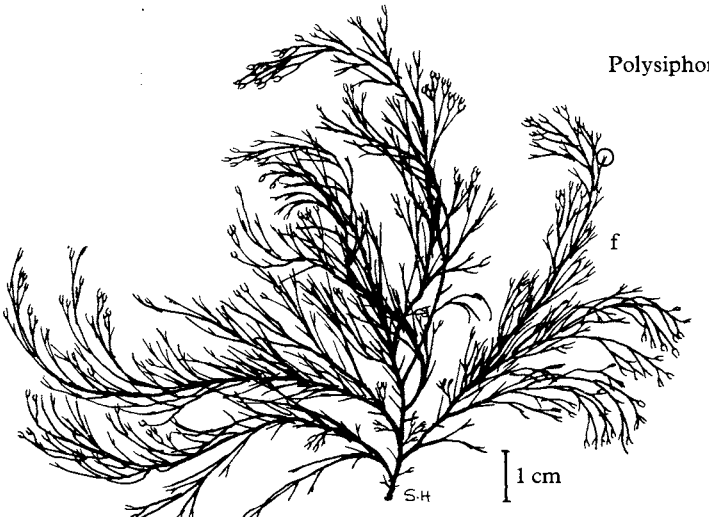
1 cm



Polysiphonia macrocarpa

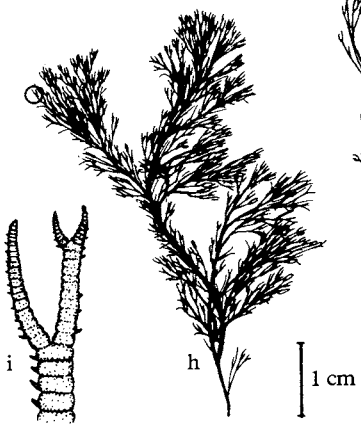


Polysiphonia violacea

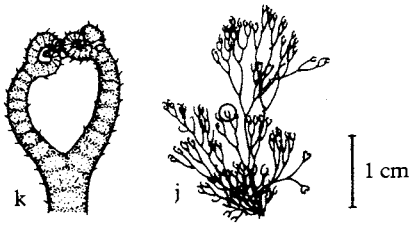


f, g. Ceramium rubrum

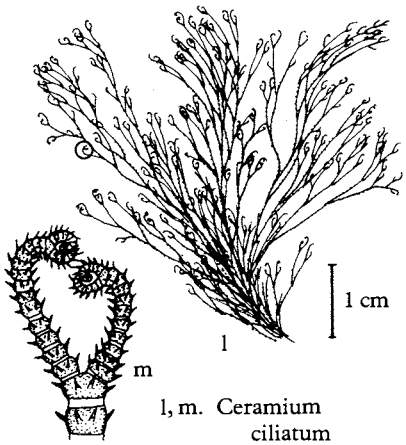
g, i, k, m, o are details of branches at apices



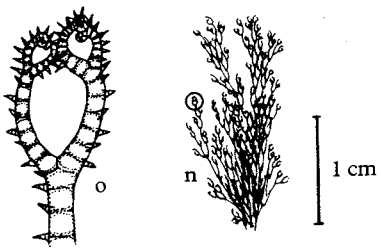
h, i. Ceramium flabelligerum



j, k. Ceramium echionotum



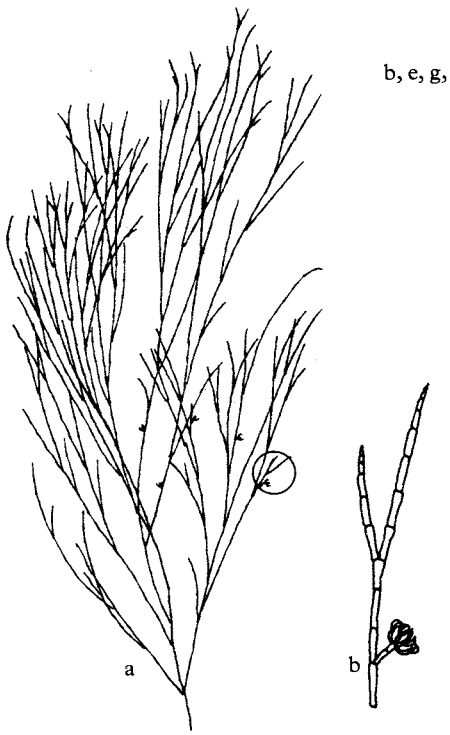
l, m. Ceramium ciliatum



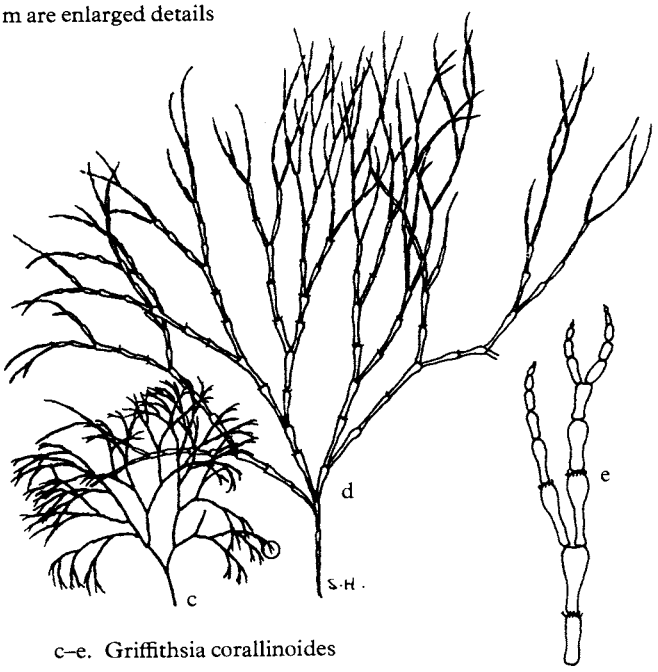
n, o. Ceramium shuttleworthianum

FIG. 32

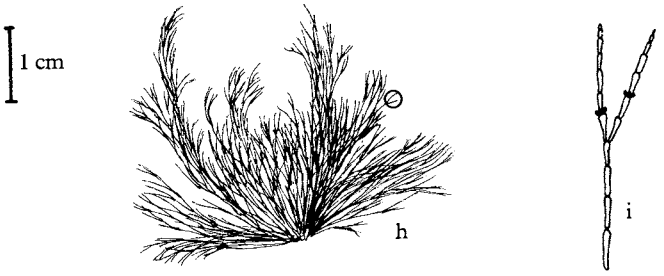
b, e, g, i, k and m are enlarged details



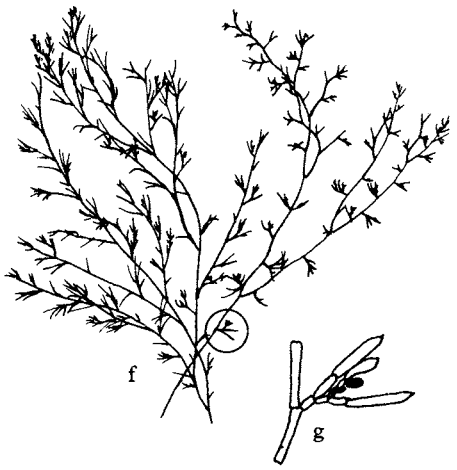
a, b. Griffithsia flosculosa



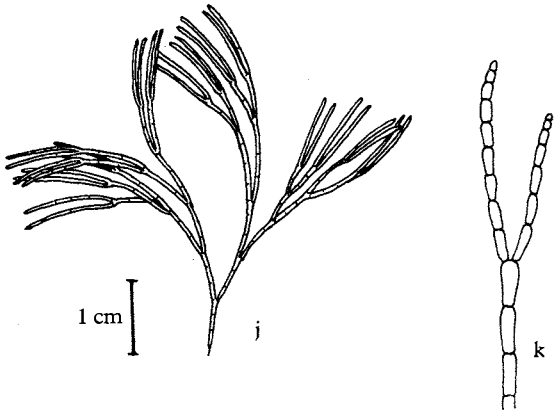
c–e. Griffithsia corallinoides



h, i. Griffithsia devonienis



f, g. Corynospora pedicellata

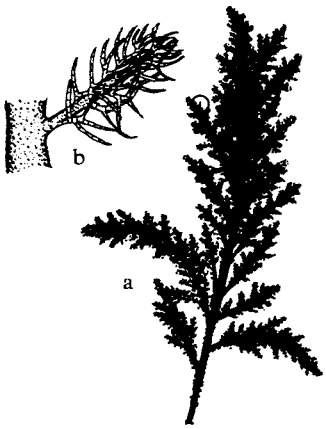


j, k. Bornetia secundiflora

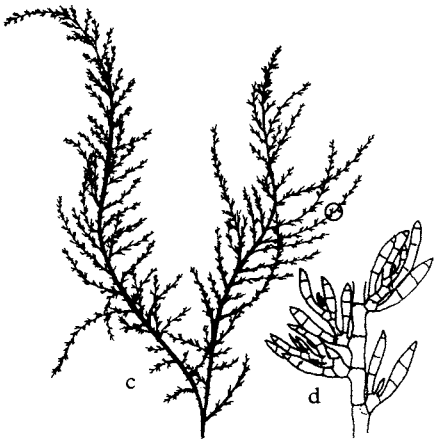
l, m. Bostrychia scorpioides

FIG. 33

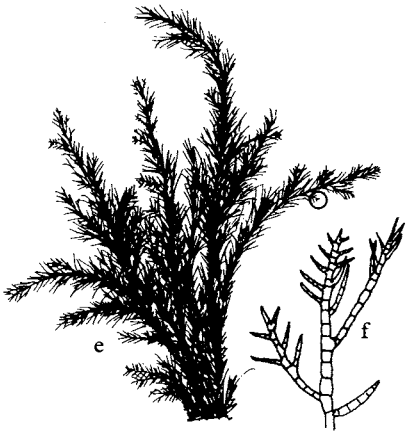
b, d, f, h, j, l, n, p, r, t, v and x are enlarged details



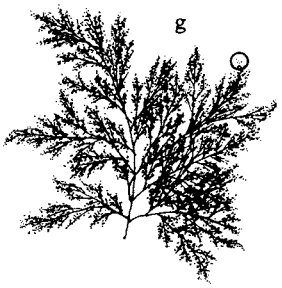
a, b. Callithamnion sepositum



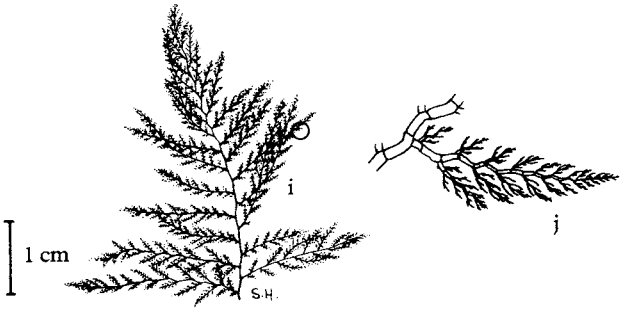
c, d. Callithamnion tetragonum



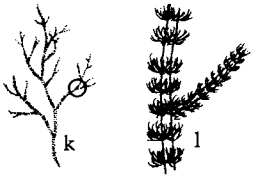
e, f. Callithamnion tetricum



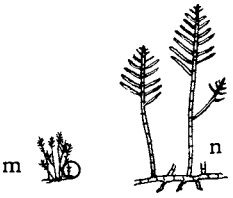
g, h. Seirospora seirosperma



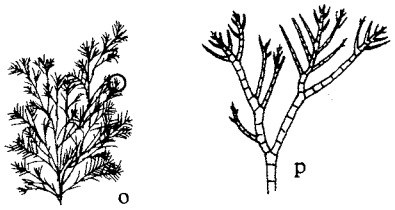
i, j. Compsothamnion thuyoides



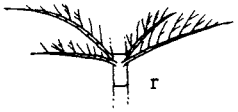
k, l. Crouania attenuata



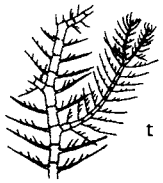
m, n. Ptilothamnion pluma



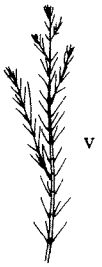
o, p. Pleonosporium borreri



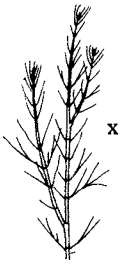
q, r. Antithamnion crispum

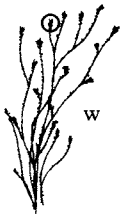


s, t. Antithamnion plumula



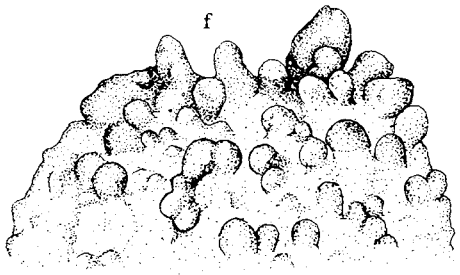
u, v. Antithamnion spirographidis



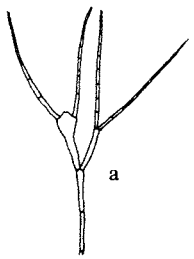


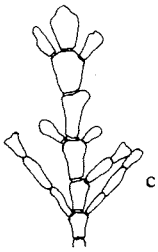
w, x. Antithamnion cruciatum

FIG. 34

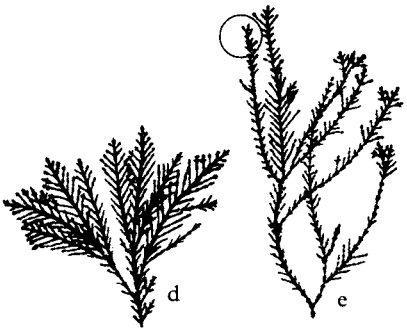


f. Lithothamnium glaciale and Phymatolithon polymorphum



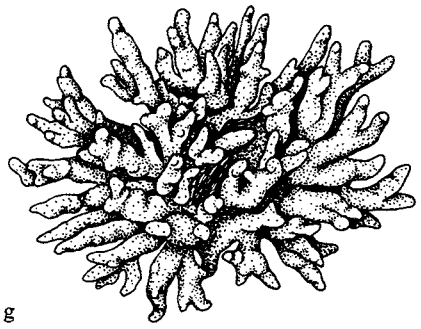


a, b. Jania rubens



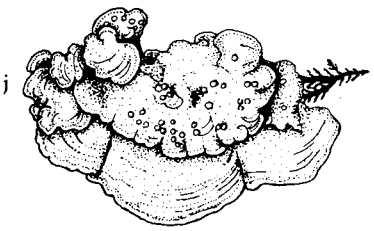
c–e. Corallina officinalis

a and c are enlarged details



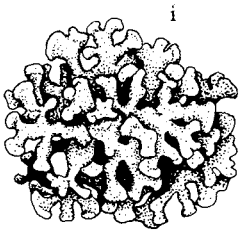
g. Lithothamnium glaciale

1 cm



j. Mesophyllum lichenoides

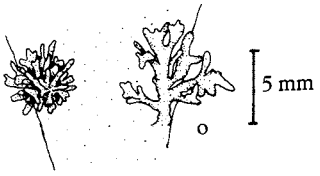
h. Lithothamnium corallioides



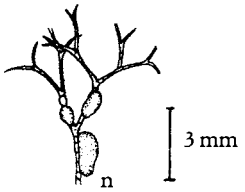
i. Phymatolithon calcareum

k. Dermocorynus montagnei (after Guiry and Maggs, 1982)

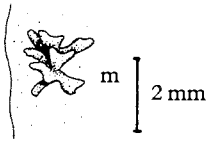
l. Ceratocolax hartzii



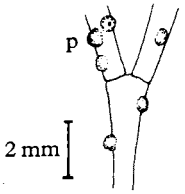
o. Rhodymeniocolax sp



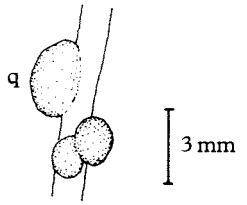
n. Choreocolax polysiphoniae



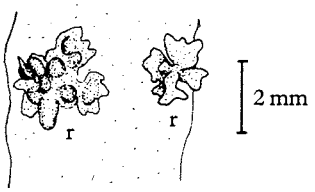
m. Callocolax neglectus



p. Choreonema thuretii



q. Holmsella pachyderma



r. Gonimophyllum buffhami

FIG. 35

FURTHER READING

A new comprehensive British marine algal flora, 'Seaweeds of the British Isles', being published by the British Museum (Natural History), will form a major reference work replacing Newton (1931). Parts 1 and 2 of the red seaweed section have already been published (Dixon and Irvine, 1977; Irvine, 1983) and the rest is expected in the not too distant future. Newton (1931) is still extremely useful, being the standard reference work on British seaweeds since its publication. It is, however, largely out of date regarding nomenclature and species habitat and distribution, and also out of print, although most university and Field Centre libraries have a copy.

A very useful set of keys to British seaweeds is in preparation (Irvine *et al.*, in preparation), and will include all British species. A key to genera is available as an offprint (Jones, 1962). Other keys to small groups are contained in some of the references below. A mini print (photographic) guide to common subtidal seaweeds (Maggs and Howson, 1985) has been recently produced with divers in mind, and is useful for identification of drift sublittoral seaweeds.

Other information is scattered in various publications. Several popular books have limited keys and illustrations, but these can be misleading and should be used with caution, as many rarer and sublittoral species are omitted, even if easily identified (Barrett and Yonge, 1958; Dickinson, 1963; Campbell, 1976). Some good photographic illustrations can be found in the floras of other European countries, although the descriptions are usually not in English (*e.g.* Kornmann and Sahling, 1977; Rueness, 1977).

The check-lists published by Parke, and Parke and Dixon since 1953 are complete lists of all known British species and contain nomenclatural changes since Newton (1931), and useful references.

Finally, Price (1978) contains many useful references for identification and further reading.

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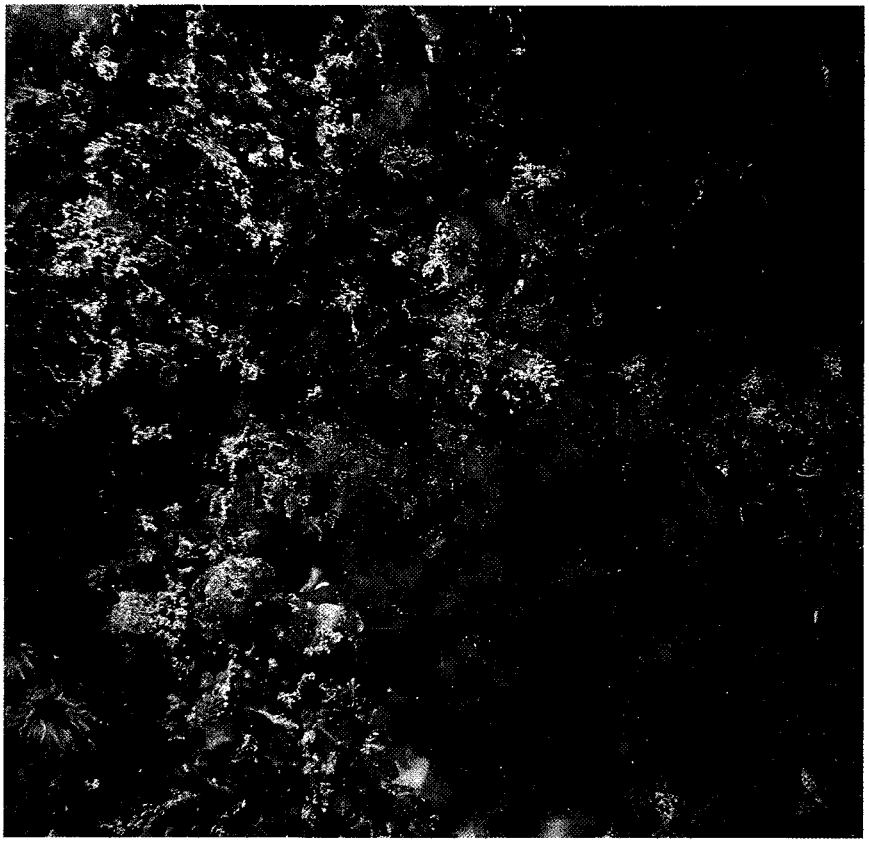

PLATE 1a.
Drachiella spectabilis

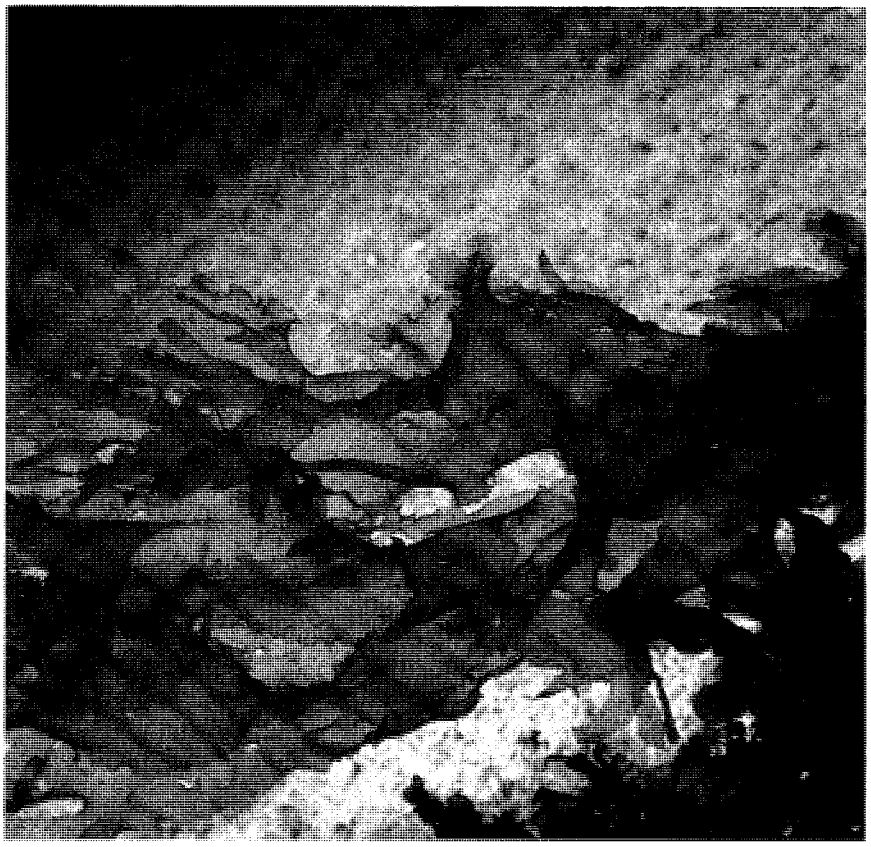

PLATE 1b.
Nitophyllum punctatum

PLATE 2a.
Mastocarpus stellatus (= *Gigartina stellata*)

PLATE 2b.
Chondrus crispus

PLATE 3a.
Solieria chordalis

PLATE 3b.
Upper (paler seaweed) *Corallina* sp.; lower (darker) *Polyides rotundus*

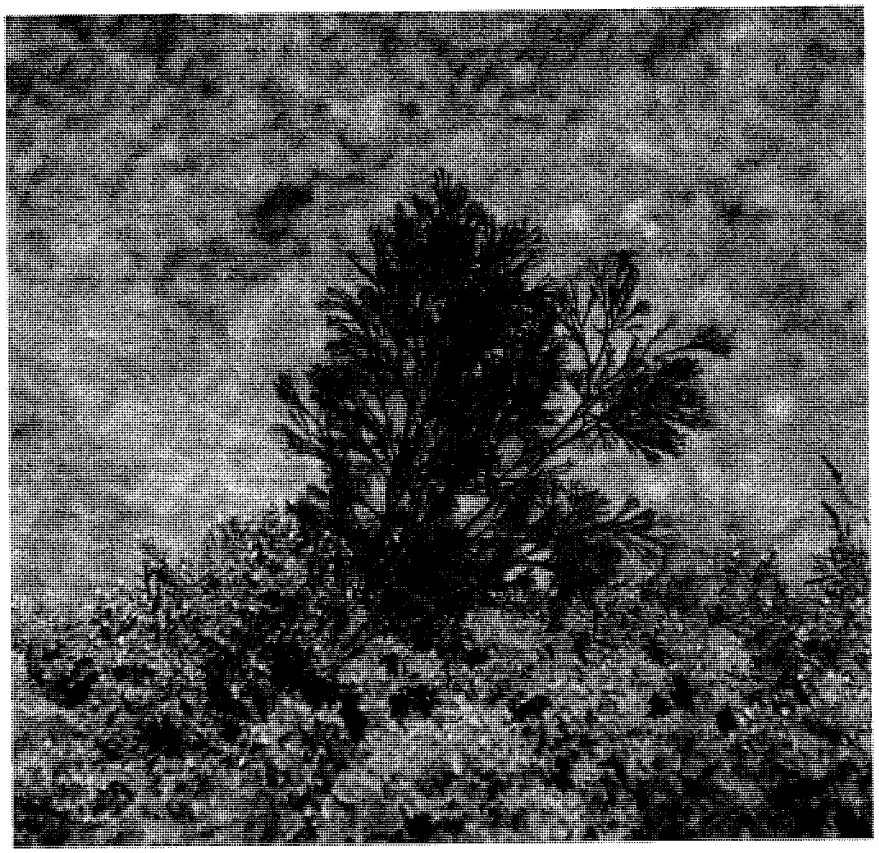

PLATE 4a.
Ceramium rubrum

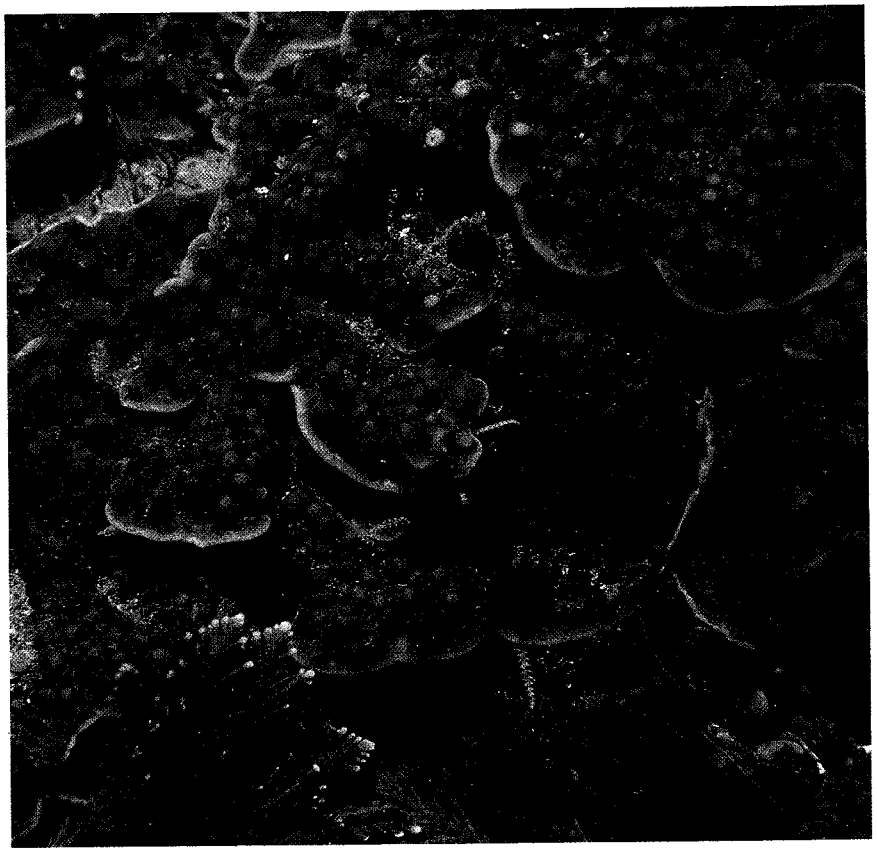

PLATE 4b.
Mesophyllum lichenoides

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ACKNOWLEDGEMENTS

I have had help from numerous sources during the compilation of this key, and am particularly grateful to Dr D. E. G. Irvine for the use of his unpublished key, and to Dr C. A. Maggs for information on crustose and other species. Also to Mrs L. M. Irvine, Dr M. D. Guiry, Dr C. A. Maggs, Dr D. E. G. Irvine and anonymous referees for reading and commenting on the manuscript. The British Museum (Natural History) staff contributed helpful discussion and supplied specimens for illustration. Some of the information on distribution of species used in the key is contained in contract reports to the Nature Conservancy Council.

Financial assistance was received from the Botanical Research Fund.

The AIDGAP project is grateful to British Petroleum for financial assistance during production of the test version.

INDEX TO SPECIES

Page number(s) refers to main description(s) of a particular species in the text. The Group letters of the keys which can be used for each species are also given in brackets, with figure numbers in heavy type. Where appropriate, plate numbers are given last (in italics)—species illustrated on the front and back covers are marked *FC* and *BC* respectively.

GLOSSARY

APEX (plural: apices)—tip of an axis, branch or ramulus
AXIS—main branch from which side branches arise (see Fig. 2); may be one (main) axis or several
ATTENUATE—narrowing, becoming pointed
BRANCHING—can be of several main types, illustrated below

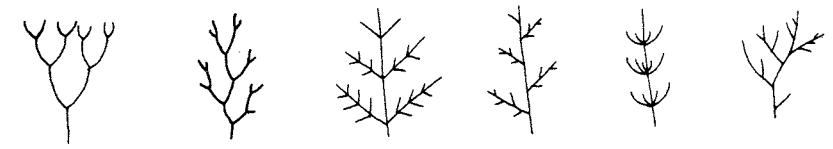
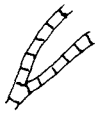


FIG. 36

BRANCHLETS—small branches, of the same structure as the main axes
BULLATE—'bubbly' surface; bulging puckered appearance
CARTILAGINOUS—of firm texture, not soft; flexible and springy
COMPRESSED—partially but not completely flattened; cross section larger in one dimension than the other
CORTICATION—a covering of small cells. See Fig 9, p. 58
CRENULATE—undulating
CUNEATE—wedge shaped
CYSTOCARP—female reproductive structure, of various forms. See Fig. 4, p. 2 and Fig. 9, p. 58
DICHOTOMOUS—See Fig. 36 above
DISTAL—away from holdfast
DISTICHOUS—arranged in two diametrically opposite rows
ECORTICATE—without cortication (see above)
EVANESCENT—not constant, fading away
FLESHY—feels relatively thick; not very thin and membranous
FILAMENTOUS—very fine, hairlike. In this key, less than 0.25 mm wide
FILIFORM—cylindrical, thicker than above, more than 0.25 mm wide
FORCIPATE—with two apices hooked inwards towards each other
FRONDS—the erect parts of a seaweed
GAMETOPHYTE—phase in the life history which produces gametes, and/or sexual reproductive structures
GELATINOUS—jelly-like texture
HOLDFAST—structure for attachment to substrate. Of various types
IRIDESCENT—plant surface reflecting light as a blue, purple or green sheen
IRREGULARLY DICHOTOMOUS—branching mainly dichotomous (see above), but occasionally branched in other ways, disturbing the regular pattern
KELP—in this key refers to *Laminaria hyperborea* (a large brown seaweed—see Hiscock, 1979). The name also applies to other members of the Laminariales
LAMINA—flat, expanded part of the thallus
LANCEOLATE—long and pointed; lance-shaped
LAX—loose, not dense
LEATHERY—thick and relatively tough, like leather
LITTORAL—the seashore above the mean low water level of spring tides. See Lewis (1964)
LUBRICOUS—slippery
MEMBRANOUS—a very thin sheet, usually translucent, sometimes with a texture almost like a polythene bag

MONOSIPHONOUS—axis made up of a single row of cells.  May also be covered with small cortical cells. See Fig. 9, p. 58

MUCRONATE—with a short point at the end
MULTISERIATE—not monosiphonous; various types of construction—flat sheets, tubes etc
NODE—junction between two sections of the axis
PINNATE—branched in one plane, appearing flattened
POLYSIPHONOUS—axes in cross-section consisting of a central cell surrounded by a number of pericentral cells. See Fig. 9, p. 58
PROLIFEROUS—small blades arising from the surface or margins of main blade, and similar in form

RAMULUS (plural: ramuli)—the smallest branches (see Fig. 2), usually of limited growth and often different in structure and/or branching to the main axes. Ramuli may themselves be unbranched, or branched in various ways
RHIZOID—root-like attachment structure, not comparable to roots in higher plants
SECUND—all branches directed to one side
SIPHON—see Fig. 9, p. 58
SORUS—a cluster of sporangia or other reproductive bodies
SPORE—a small reproductive structure (the seaweed equivalent of seeds)
STICHIDIUM—a special reproductive structure; see Fig. 9, p. 58
STIPE—a stalk-like portion arising from the holdfast, and bearing a lamina
STOLON—creeping branches, attached to the substrate or creeping within it, from which erect fronds arise
SUBDICHOTOMOUS—see Fig. 36 opposite. Basically dichotomous but with one dichotomy of limited growth and the other continuing to grow
SUBLITTORAL—approximately below the mean low water level of spring tides. See Lewis (1964)
TERETE—cylindrical, round in cross-section
TETRASPORE—spore produced by division of a cell into 4. Division of three basic types:

THALLUS—the whole algal plant
TRUNCATED—blunt ended, as if cut across
WHORLED—see Fig. 36 opposite